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ABSTRACT

Described is an experimental, quantitative model developed by the New York State Education Department to evaluate state-level financing strategies for higher education. It can be used to address a variety of questions and takes into account a host of direct and indirect relationships. It uses computer software and optimization algorithms developed by the National Center for Higher Education Management Systems, and was part of the pilot test activities of that organization's State Planning Systems. The model is not expected to become an operational tool in the near future, but will continue to be refined. (Author/MSE)

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An Experimental Model for Analyzing Strategies For Financing Higher Education in New York State

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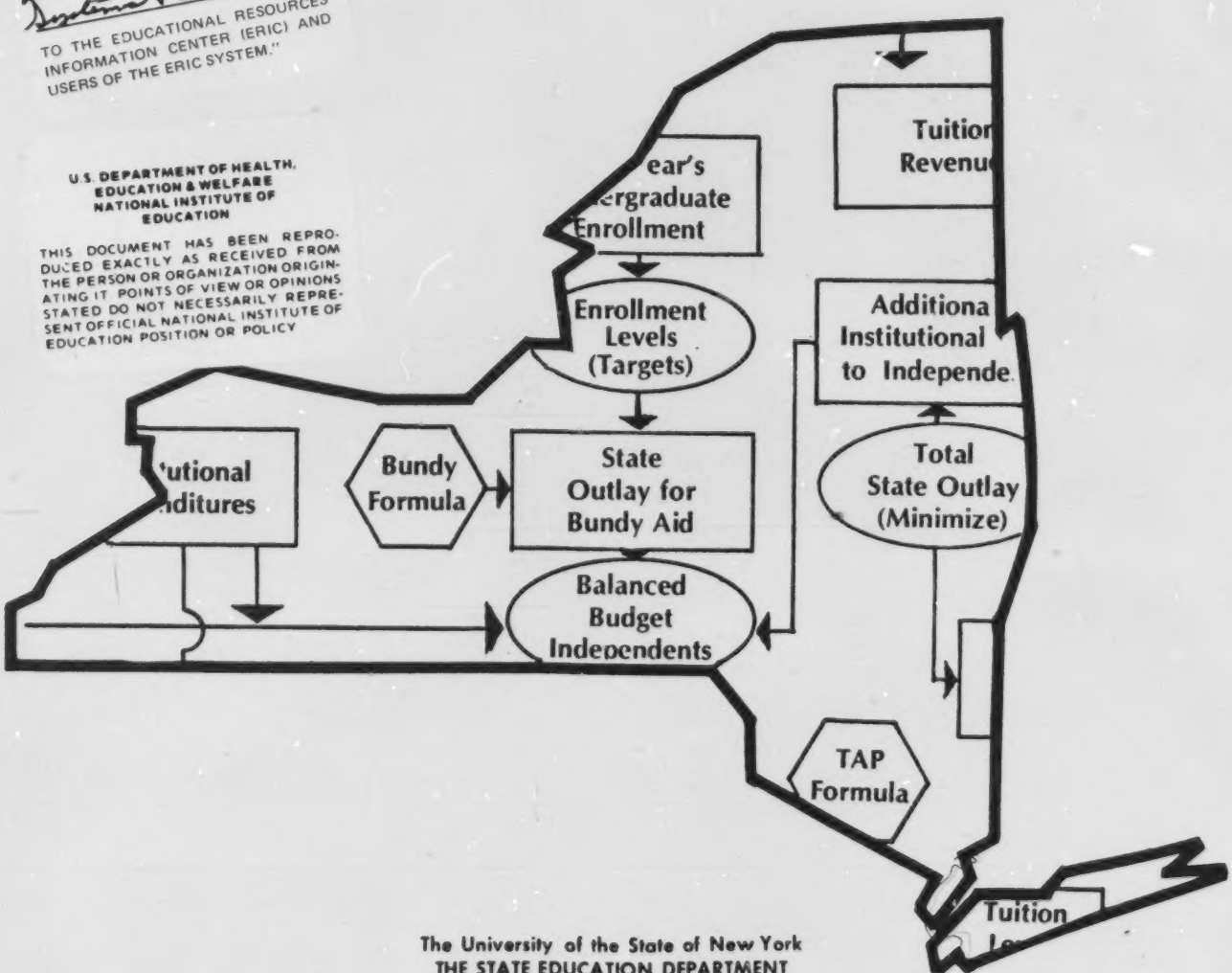

The University of the State of New York
THE STATE EDUCATION DEPARTMENT
Office of Postsecondary Research,
Information Systems and Institutional Aid
Albany, New York 12230

HE010181

AN EXPERIMENTAL MODEL FOR ANALYZING STRATEGIES FOR FINANCING HIGHER EDUCATION IN NEW YORK STATE

December 1977

The University of the State of New York
THE STATE EDUCATION DEPARTMENT
Office of Postsecondary Research,
Information Systems and Institutional Aid
Albany, New York 12230

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PAUL WING

FOREWORD

This report describes an experimental, quantitative model developed by the New York State Education Department to evaluate state-level financing strategies for higher education. The model, which is both complex and comprehensive, incorporates state-of-the-art analytical procedures and optimization techniques. It can be used to address a variety of questions and it takes into account a host of direct and indirect relationships. It is one of the most sophisticated tools ever developed specifically for state-level higher education planning.

Although an attempt has been made to minimize the use of technical jargon in the report, the reader is assumed to have some familiarity with quantitative modeling. The Summary and Conclusions and the statement by the project advisory committee in Appendix D have been written for a nontechnical audience.

Although the model was developed by the New York State Education Department, it uses computer software and optimization algorithms developed by the National Center for Higher Education Management Systems (NCHEMS). In fact, the development of the model was part of the pilot test activities of the State Planning Systems (SPS) at NCHEMS.

The State Education Department, though not one hundred percent satisfied with the State Financial Planning Model, is sufficiently interested to continue developing and refining it. The model is not expected to become an operational tool in the near future; but as various aspects of the model are examined, refined, and improved it will be used in analyzing and evaluating selected policy recommendations.

Comments, questions, and suggestions concerning the model or this report are welcome. They can be directed to Paul Wing at (518) 474-5091.

ACKNOWLEDGEMENTS

The development of this experimental State Financial Planning Model was monitored by the Policy Analysis and Planning Advisory Committee. This Committee provided constructive criticism about the model, this report, and possible uses of the model. In addition, the Committee prepared a brief statement about the model and its development which is included in Appendix D of this report. The Committee members deserve special thanks for their contribution to this project:

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New York State Assembly

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School of Management
Rensselaer Polytechnic Institute

Thanks are also due to the staff that worked on this project over the past two years, particularly Shimon Awerbuch, Steve Cohen, Judy Hutchison, Peggy Norton, Philly Parella, Glen Rowse, and Paul Wing. Vaughn Huckfeldt and Mark Chisolm of NCHEMS also provided assistance.

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CHAPTER 1

INTRODUCTION

The higher education system in New York State is large and complex. Nearly one million students are enrolled in the 13,000 degree and certificate programs currently offered by the 250 degree-granting institutions in the State. The State annually allocates over $1 billion, more than 10 percent of its budget, to support this system. This is done through a variety of appropriations and aid programs.

Although the postsecondary system in New York State enjoys a good reputation both locally and nationally, it is coming under increasing scrutiny as concerns about public spending and competition for tax dollars increase. The prospect of declining enrollments in the 1980's provides further incentives for better information and better tools to support state-level planning and policy formulation. Recent developments in both data processing and quantitative analysis techniques, however, have raised the question: Can these new tools help the Board of Regents and other planners and policy makers concerned with postsecondary education in New York State make decisions and allocate resources more effectively?

The Policy Analysis and Planning Project was established by the State Education Department in 1975 to address this question. Through this project a number of quantitative models for studying state-level financing strategies have been developed and tested, and their utility and applicability in the postsecondary education planning process has been evaluated. This report documents these models and their application to a number of policy problems.

The models developed in the project have been designed to permit the study of the interaction of students, institutions, and State government,

with particular attention to the implications of different financial support strategies and tuition policies. These models and the results they provide are interesting in their own right, but the primary objective of the project is to evaluate the potential of these kinds of models in the actual planning process.

Among the specific research issues addressed in the project is whether it is feasible to provide relevant policy measures in sufficient detail so that they are helpful in the policy making process. A related question is whether policymakers can trust these kinds of models and the data required for their operation.

The remainder of the report is organized as follows: Chapter 2 defines a manageable problem in the context of the New York State post-secondary education system. Chapter 3 describes the model and quantitative relationships, while the analytical results and policy implications are discussed in Chapter 4. Chapter 5 provides a summary of the report along with some recommendations regarding the use of complex, quantitative models in the planning process. In addition to the body of the report, there are appendices which provide additional information about the model and the estimation of coefficients used.

CHAPTER 2

THE PLANNING PROCESS IN THE NEW YORK STATE POSTSECONDARY EDUCATION SYSTEM

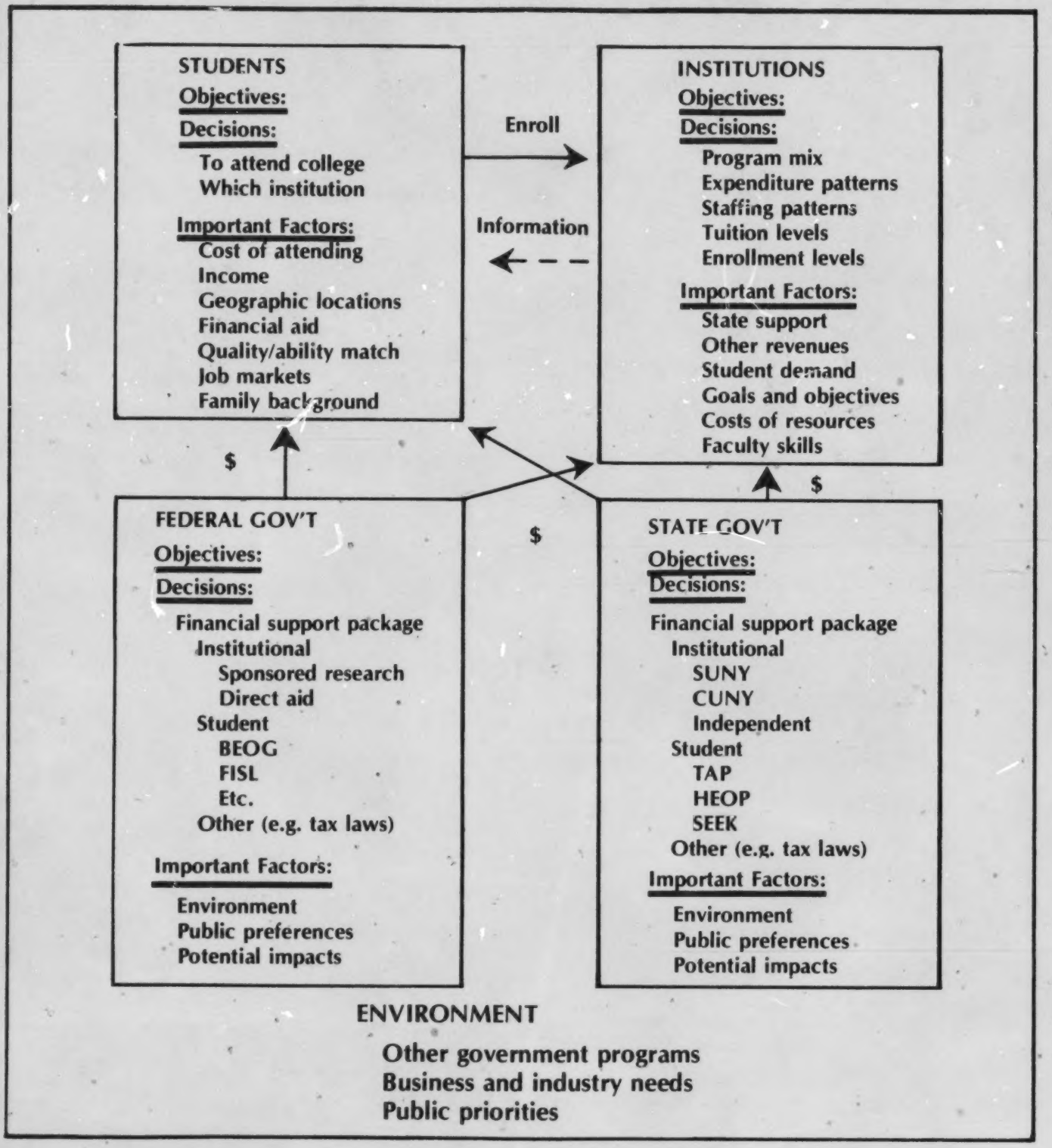
Defining a Manageable Problem

There are many concepts and relationships that are important to a thorough understanding of postsecondary education in New York State. Each of these has related to it one or more questions or problems that must be dealt with by planners and policy makers. They range from relatively limited problems like estimating the future enrollment levels to comprehensive problems related to the allocation of resources.

In addition to the variety of problems that must be sorted through and dealt with, there are a number of diverse perspectives and "actors" that must be considered in formulating quantitative approaches to any of these problems. Students and potential students, the institutions, a variety of state agencies, and the Federal government are among the parties whose interests or roles may be significant enough to warrant explicit consideration in any analytical model. Figure 2.1 defines one view of the dynamics of the postsecondary education system, emphasizing the active participants, the important decisions that they make, and important factors influencing their decisions.

Important components of the system include the students, the State, the institutions, and the Federal government. These all interact within a complex environment to create the demand for specific programs and activities through a variety of mechanisms. The institutions are seeking to attain their own short- and long-term objectives, which may include high quality of their academic programs and continued institutional viability. The State influences the behavior of institutions through

FIGURE 2.1
SCHEMATIC REPRESENTATION OF RELATIONSHIPS AMONG IMPORTANT DECISION MAKERS IN POSTSECONDARY EDUCATION



policies developed by the Board of Regents and fiscal mechanisms such as direct appropriations, aid to non-public institutions, and tuition assistance for students. The students, of course, affect the system through their decisions to attend different institutions and programs.

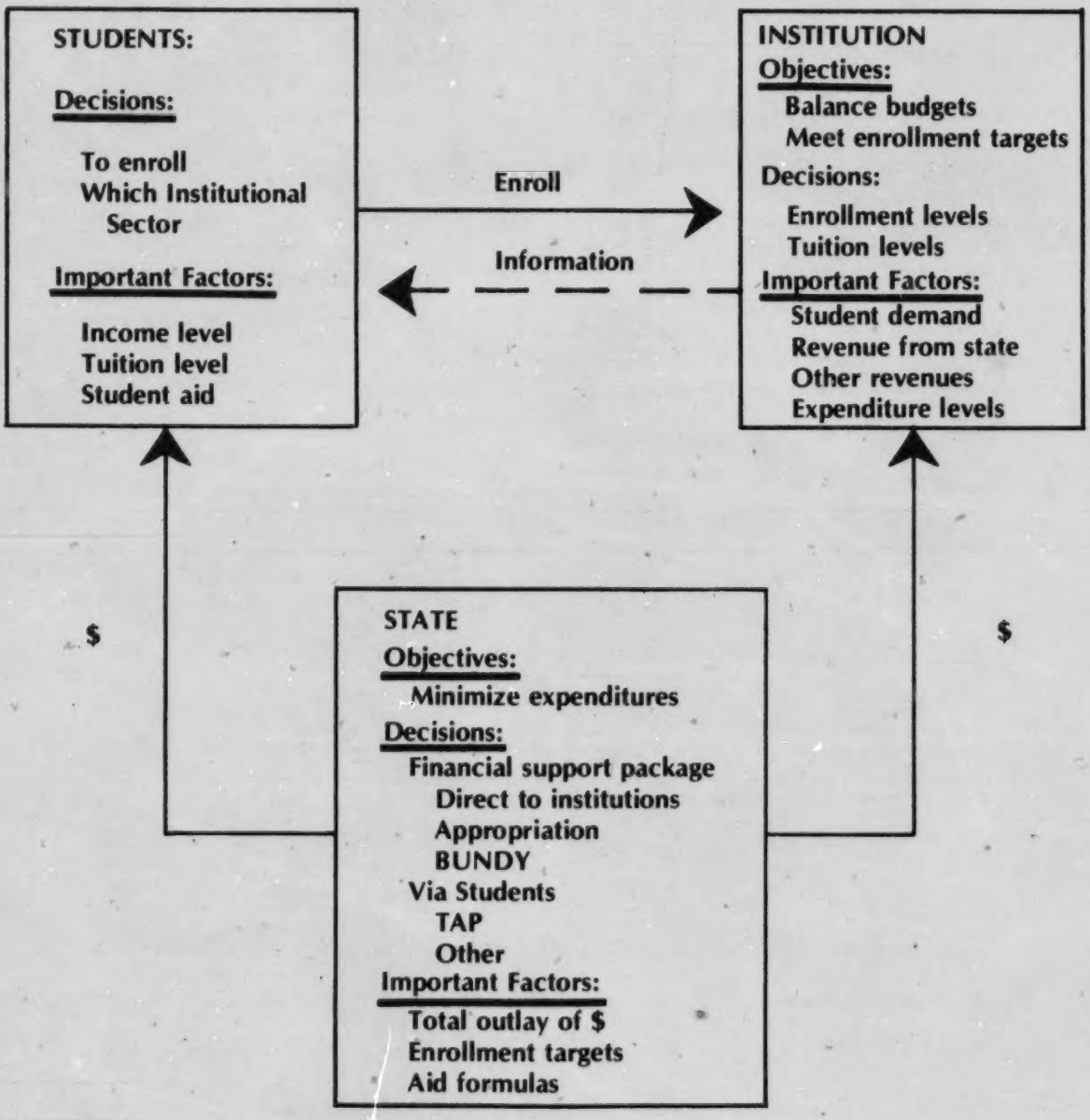
In practice, Figure 2.1 is too comprehensive to use as a basis for any quantitative model. There are too many factors and interrelationships implied in this diagram to account for in a systematic way. Even if a set of equations could be developed to represent all aspects of this model, the computational requirements would be overwhelming.

What is required is a more restricted frame of reference, one which can be translated into a manageable set of quantitative relationships for analysis. Figure 2.2 suggests one possible subset of Figure 2.1 for consideration. This omits all Federal government roles and actions, restricts the factors governing student decisions to economic ones, eliminates all but the most important State financial support mechanisms, and eliminates any consideration of factors outside postsecondary education. It is this set of factors and relationships shown in Figure 2.2 that is the basis for the model described in subsequent chapters of this report.

BASIC DATA ON HIGHER EDUCATION IN NEW YORK STATE

One way to illustrate the complexity of the postsecondary education system is to provide some of the basic data and relationships that will be used in the models. The description covers a number of the important aspects of postsecondary education in New York State including enrollments, institutional finances, State outlays for education, State aid programs for postsecondary education, and the major institutional sectors in the State. These basic data and relationships indicate some of the factors

FIGURE 2.2
SUBSET OF FACTORS AND RELATIONSHIPS IN
POSTSECONDARY EDUCATION PROPOSED FOR ANALYSIS



that must be taken into account in developing financing strategies. Many of the numbers are incorporated into the models discussed in chapters 3 and 4.

Enrollments

During the 1960's enrollment in higher education more than doubled in the United States. At the present time enrollments are stabilizing and projections indicate that they will decline significantly over the next decade and a half.

In New York State, full-time undergraduate enrollment in degree-granting institutions increased from 400,000 to almost 550,000 in the six-year period 1969 through 1975. This enrollment is expected to decline about 9 percent by 1980 at which time just over 500,000 students will be enrolled in full-time undergraduate study (Board of Regents, 1976a).* By 1990 the State Education Department projects a full-time undergraduate demand of less than 385,000, a decrease of 30 percent from the 1975 base.

The projections referred to above assume that the in-state college going rate of 53 percent for high school seniors will continue. A second, more optimistic set of projections was derived to establish an upper bound on the projected demands for 1980. Table 2.1 presents a summary of actual and projected (high and low) New York State enrollments from 1969 to 1990.

For the purposes of the models described in this report more detailed enrollment projections are required. Costs and revenues vary by institutional sub-groupings and it is therefore necessary to examine enrollments by institutional type. Table 2.2 gives actual and projected enrollment data by institutional sub-sector. Tables B.4 to B.8 in

*See page 109-110 for complete biographical listings.

Table 2.1
FULL-TIME UNDERGRADUATE ENROLLMENT IN NEW YORK STATE
ACTUAL AND PROJECTED FOR SELECTED YEARS

	Fall '69 (Actual)	Fall '75 (Actual)	1980 Projected Low	1980 Projected Hi	1984 Projected Low	1984 Projected Hi	1990 Enrollment Goal
Public	328,874	347,835	313,400	322,300	298,600	308,350	384,350
Private	185,663	201,339	187,100	194,200	175,100	182,850	
	514,537	549,174	500,700	520,000	473,700	491,200	384,350

SOURCE: Actual: Postsecondary Information Systems, HEDS.
Goals: Board of Regents, 1976a.

Appendix B describe these enrollments incorporated into the planning model in more detail.

Institutional Finances

Total enrollments increased sharply during the period 1969-73, and the costs of providing educational services also rose substantially. A commonly used measure of expenditures for instruction in higher education is the current fund category "Educational and General Expenditure," which is an accounting term that is used by most higher education institutions. It includes such items as the cost of instruction, libraries, student services, and general administration. Excluded are Student Aid outlays, Major Service Programs, and expenditures for Auxiliary Enterprises such as food, housing and athletics. When divided by the number of students, it provides an estimate of the average expenditures devoted to each student. Table 2.3 shows the percent increases in Educational and General Expenditures per Full-Time Equivalent Student (FTE's) for the major sub-groups of private institutions in the recent past.

Table 2.2
FULL-TIME UNDERGRADUATE ENROLLMENT IN NEW YORK STATE

By Control, By Type of Institution
Fall 1974, 1975 Actual; Fall 1976-1975 Expectations
Fall 1980 and 1984 Goals

Type of Institution	Fall 1974 Actual	Fall 1975 Preliminary	Enrollment Expectations				Enrollment Goals			
			Fall 1976	Fall 1977	Fall 1978	Fall 1979	Fall 1980		Fall 1984	
							Low	High	Low	High
FOUR-YEAR										
Public										
State University	104,493	111,634	104,100	105,950	107,750	109,600	111,400	117,100	98,100	100,450
City University	87,220	87,550	73,050	59,000	52,400	55,300	58,200	60,000	70,000	76,000
Sub-Total Public	191,713	199.184	177,150	164,950	160,150	164,900	169,700	177,100	168,100	176,450
Independent	172,301	184,254	186,300	189,300	187,850	178,650	169,100	176,200	157,100	164,850
TOTAL FOUR-YEAR	364,014	383,438	363,450	354,250	348,000	343,550	338,800	353,300	325,200	341,300
TWO-YEAR										
Public										
State University	(93,223)	(104,158)	(103,800)	(102,050)	(100,250)	(98,500)	(96,700)	(97,200)	(90,500)	(90,900)
Ag. & Tech.	20,716	21,097	20,000	19,550	19,050	18,600	18 100	18,100	17,400	17,500
Community Coll.	72,557	83,061	86,000	82,500	81,200	79,900	78,600	79,100	73,100	73,400
City University	43,938	42,655	45,000	46,700	54,000	50,500	47,000	48,000	40,000	41,000
Sub-Total Public	137,161	146,813	151,000	148,750	154,250	149,000	143,700	145,200	130,500	131,900
Independent										
Traditional	6,024	7,140	7,000	6,900	6,800	6,700	6,600	6,600	6,300	6,300
Degree-Program	7,338	10,985	11,000	11,100	11,200	11,300	11,400	11,400	11,700	11,700
Sub-Total Indep.	13,362	18,125	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000
TOTAL TWO-YEAR	150,573	164,938	169,000	166,750	172,250	167,000	161,700	163,200	148,500	149,900
GRAND TOTAL	514,587	548,376	532,450	521,000	520,250	510,550	500,500	516,500	473,700	491,200

SOURCE: Actual: Postsecondary Information Systems, HEDS; Expectations and Goals: Board of Regents, 1976.
NOTE: Numbers in parentheses are subtotals of Ag. & Tech. and Community College Enrollments.

Table 2.3
PERCENTAGE INCREASE IN EDUCATION AND GENERAL EXPENSE PER FULL-TIME EQUIVALENT STUDENT FOR NEW YORK STATE COLLEGES AND UNIVERSITIES

Sub-Groups of Institutions	1966-67 to 1969-70	1969-70 to 1972-73
Major Universities	38.7 %	28.6 %
Private Universities of Greater New York City	25.0 %	20.2 %
Large Colleges	12.0 %	26.1 %
Small Colleges	22.6 %	10.9 %
Engineering and Technical Schools	24.9 %	18.2 %

SOURCE: State Education Department, 1974.

Institutional Expenditures by Purpose

The Higher Education General Information System (HEGIS) operated by the Federal government classifies operating expenditures into four major categories: Educational and General, Student Aid, Major Service Programs, and Auxiliary Enterprises. Of these, Educational and General Expenditures (E & G) is by far the largest, accounting for 66 to 90 percent of total operating outlays depending on the subgroup of institutions. Within this category, Instruction and Departmental Research outlays are the major source of expenditure and range from 30 to 60 percent of total E & G. Table 2.4 presents the operating expenditures for public and independent institutions in New York State for the fiscal year ending 1974. The total current expenditure at public institutions that year was about $1.72 billion or $3,400 for each full-time equivalent (FTE) student, while the independent institutions expended $6,800 per FTE student for a total of $1.802 billion. Due to accounting differences these two figures are not entirely compatible, but they do reflect basic differences between public and independent institutions.

Table 2.4
CURRENT EXPENDITURES OF NEW YORK STATE COLLEGES AND UNIVERSITIES
FISCAL YEAR 1973-74
($ millions)

	Public	Independent	Total
• Educational & General (Total)	$1,309.3	$1,425.9	$2,735.2
Instruction and Dept. Research	668.1	429.2	1,097.3
Organized Activity Related to Education Department	26.7	175.3	202.0
Sponsored Research	73.3	150.6	223.9
Other Separate Budgeted Research	.2	69.8	70.0
Other Sponsored Programs	51.0	108.2	159.2
Extension and Public Service	21.6	10.0	31.6
Libraries	48.2	50.7	98.9
Operation and Maintenance of Plant	130.1	148.2	278.3
Student Services	69.2	51.5	120.7
General Administration	110.7	64.3	175.0
General Institutional Expenditures	40.8	103.7	144.5
Other Expenditures	69.1	64.3	133.4
• Student Aid (Total)	77.5	111.7	189.2
• Major Service Programs (Total)	40.6	66.9	107.5
• Auxiliary Enterprises (Total)	65.7	198.1	263.8
Food and Housing	58.7	125.8	184.5
Other (Stores, athletics, etc.)	7.0	72.2	79.2
• Debt Service	129.0	*	129.0
• Fringe Benefits	98.0	*	130.0
• Total Current Expenditures	$1,720.1	$1,802.6	$3,554.7

*Already incorporated in above figures.

SOURCES: Postsecondary Information System, HEDS; State Education Department, 1976.

The detailed expenditure data shown in Table 2.5 indicate the basic accounting data provided by higher education institutions. Although the definitions for each fund item are quite specific (in the HEGIS data collection forms), comparison of the reported figures with those from other sources indicates reporting inconsistencies. The student aid category is the most vulnerable to discrepancies, with some schools including such pass-throughs as guaranteed loans in the student aid category. Despite these discrepancies, this basic financial information is relatively accurate and certainly suitable for evaluating and formulating financing strategies.

State Outlays for Education

Public expenditures for higher education in the state have increased steadily in recent years, although the outlays have remained relatively constant in proportion to the total state budget (11-12 percent). Higher education expenditures increased from $839,800,000 in 1971-72 to $1,229,700,000 in 1975-76. These outlays are for a variety of programs and purposes, including direct support of the State University (SUNY) system, shared payments for The City University of New York (CUNY), funding of the Tuition Assistance Program (TAP), and the Assistance to Non-Public Institutions ("Bundy Aid").

Table 2.6 shows the expenditures for the major state program in higher education. A brief description of each major category is given below.

State University of New York:

The Legislature makes annual appropriations to support the operation of SUNY State Operated Campuses. This group of institutions consists of

Table 2.5
CURRENT FUND REVENUES FOR NEW YORK STATE COLLEGES AND UNIVERSITIES
FISCAL YEAR 1973-74
($ millions)

	Public	Independent	Total
• Educational & General (Total)	$1,352.0	$1,503.9	$2,855.9
Tuition & Fees	213.7	652.9	866.6
Governmental Appropriations	1,059.9	85.5	1,145.5
Federal	12.1	15.7	27.8
State	743.2	69.4	812.6
Bundy	—	53.0	53.0
Local	304.6	.4	305.0
Endowment Income	1.0	93.9	94.9
Private Gifts	.5	108.0	108.5
Sponsored Research	74.6	185.3	259.9
Federal	38.4	152.0	190.4
State	24.3	2.6	26.9
Local	3.2	2.6	5.8
Other	8.8	28.1	36.9
Other Sep. Budgeted Research		.3	.3
Other Sponsored Programs	66.6	136.6	203.2
Federal	34.0	50.8	84.8
State	5.9	6.7	12.8
Local	12.1	67.9	80.0
Philanthropic	5.2	3.9	9.1
Other Private	9.4	7.3	16.7
Recovery of Indirect Costs	2.4	58.8	61.2
Sales & Service of Education Depts.	1.9	4.8	6.8
Organized Activ. Related to Educ. Depts.	3.0	121.1	124.1
Other Sources	13.2	56.7	69.9
• Student Aid (Total)	60.6	63.0	123.6
Federal	20.5	25.9	46.4
State	38.8	3.2	42.0
Local Government	.0	.4	.4
Gifts and Grants	.8	10.1	10.9
Endowment Income	.4	12.8	13.2
Other	.1	10.5	10.6
• Major Service Programs (Total)	41.0	68.9	109.9
• Auxiliary Enterprises (Total)	49.3	186.6	235.9
• Total Current Revenues	$1,502.8	$1,822.4	$3,325.2

SOURCE: Postsecondary Information System, HEDS.

Table 2.6
STATE APPROPRIATIONS FOR HIGHER EDUCATION IN NEW YORK STATE
1971-72, 1975-76 and 1976-77
($ millions)

	Amounts			Percent Change	Percent of Total	
	1971-72	1975-76	1976-77	1971-76	1971-72	1976-77
State Univ. of NY[1]	$ 472.7	$ 667.4	$ 636.0	34.5%	57.0%	51.1%
City Univ. of NY[2]	90.0	140.4	117.3	30.3	10.8	9.4
Community Colleges[2]	92.0	148.0	156.0	69.6	11.1	12.5
Aid to Non-Public Institutions						
Bundy Aid[3]	26.9	57.4	59.9	122.7	3.2	4.8
Health Prof. Educ.	12.9	19.0	16.0	24.0	1.6	1.3
Aid to Students[4]	75.5	133.0	198.1	162.4	9.0	15.9
Prog. for Disadvantaged Students	44.3	44.2	38.9	(12.2)	5.3	3.1
Other State Educ. Support & Programs	8.0	7.9	8.0	-	1.0	.6
Other SUNY Programs	1.7	2.2	2.0	17.6	.2	.2
Other State Agencies and Special Prog.	5.8	10.2	13.0	124.1	.7	1.0
TOTAL	$ 829.8	$1,229.7	$1,245.2	50.1%	100.0%	100.0%

[1]Excluding certain programs covered in categories below and including estimates of funds for employee benefits.

[2]State share of operating budgets, including special appropriation for CUNY of $24.0 million for 1975-76.

[3]Aid formula increased by average of about 60 percent in 1973; sixteen additional institutions became eligible for aid between 1971-72 and 1976-77.

[4]Increase mainly attributable to adoption of Tuition Assistance Program in 1974.

SOURCE: Board of Regents, 1976a.

four university centers offering a full range of undergraduate and graduate education, thirteen university colleges, and eleven Agricultural and Technical and statutory colleges. Debt service for these campuses is met with income derived from tuition and fees, dormitory and hospital operations, and miscellaneous sources such as fines and forfeitures. The excess of this income over the debt service requirements (known as the "income or tuition offset") is used for operating purposes. Therefore, the annual state appropriations are for operating expenses, as reduced by the tuition offset.

The City University of New York:

The City University consists of ten senior colleges, eight community colleges and the Graduate Center. The Mayor of the City of New York certifies annual operating budgets for these institutions. The State matches the City's expenditures for operation of the senior colleges (under old appropriation formula). The amounts made available for this matching totaled $102.6 million (net of $24 million "made available" for 1975-76) in 1976-77, with an additional $59.5 million provided to the eight community colleges under the statewide formula.

Community Colleges:

There are 30 community colleges throughout the State which are partially supported by state outlays. Payments are provided under a formula which enables these institutions to receive up to 40 percent of their operating expenses from the State, with the average support at approximately 37.5 percent.

Aid to Non-Public Institutions (Bundy Aid):

About 90 independent institutions in the State receive assistance under this program. The funding formula is based on the number of degrees awarded by an institution as follows:

Table 2.7
SCHEDULE OF BUNDY AID PAYMENTS FOR 1975-76 AND 1976-77

Degree Type	1975-76 (payment per degree conferred in 1974-75)	1976-77 (payment per degree conferred in 1975-76)
Associate	$ 300	$ 300
Baccalaureate	800	940
Master's	600	650
Doctorate	3,000	3,100

In addition to the Bundy Aid, the State provides substantial support for health professional education programs in non-public institutions. This is primarily in the form of capitation grants for enrollment expansion in medical and dental schools.

Aid to Students:

The Tuition Assistance Plan (TAP) is the largest of the student aid programs in New York State. Approximately 65 percent of New York State students (235,620 for 1974-75) apply for this program, which provides aid to students on a formula basis in an amount not to exceed tuition. Total State TAP outlays exceeded $100 million in the 1975-76 academic year compared with $88.6 million for 1974-75 (Higher Education Services Corporation, 1975).

The TAP formula consists of a maximum award (the lesser of $1,500 or tuition charge) which is then reduced by an amount dependent

on the net taxable balance. The net taxable balance is the family's New York State net taxable income, less $3,000 for a second child enrolled in higher education. The exclusion for additional students in the family is $2,000 per student. The program further provides that for a net taxable income of under $20,000, the minimum award shall be $100.

The schedule is as follows:

Table 2.8
SCHEDULE OF TAP AWARDS FOR 1976-77

Net Taxable Balance	Reduction from Maximum Award
$ 2,000 or less	-0-
2,001 - 8,000	6% of the excess over $2,000
5,001 - 11,000	$180 plus 7% of the excess over $5,000
8,001 - 11,000	$390 plus 8% of the excess over $8,000
11,001 - 14,000	$630 plus 10% of the excess over $11,000
14,001 - 17,000	$930 plus 12% of the excess over $14,000
17,000 - 17,785	$1,290 plus 14% of the excess over $14,000
17,786 - 20,000	$1,400 (minimum award will be $100)
20,001 or more	No award given

Regents College Scholarships are also provided by the State. This award is given on the basis of qualifying examinations. Under recent legislation the amount of award is fixed at $250 per recipient. The cost of this program is approximately $24 million per year.

A program is also active to provide aid to children of veterans. In 1974-75 there were 3,446 recipients of this award. Total payments amounted to $1.4 million.

There are several other student aid programs including War Service Scholarships, Medical-Dental Scholarships, Lehman Fellowships and Basic Nursing scholarships which account for approximately $1.8 million in annual payments to approximately 3,500 students.

Programs for Disadvantaged Students:

The HEOP, EOP, and SEEK programs for disadvantaged students have been operating for a number of years as means for overcoming barriers that exist for minority students. Although there has been a decline in the funding of these programs recently, the programs are still active.

Federal Aid Programs:

In addition to State aid programs, there are also a number of Federal aid programs. With minor exceptions, these programs do not directly affect the State's fiscal situation but impact primarily on the student body. The table below presents the major programs and payments received by New York State students during 1974-75. Omitted are certain grant programs such as Veterans' Educational Benefits, and the Law Enforcement Grants.

Table 2.9
AMOUNTS OF FEDERAL STUDENT AID FOR HIGHER EDUCATION
RECEIVED BY NEW YORK STATE IN 1974-75

Federal Aid Program	Number of Eligible Students	1974-75 Payments (millions of $)
Basic Educational Opportunity Grant	80,000	$ 38.0
Supplemental Educational Opportunity Grant	24,000	16.8
College Work-Study	40,000	19.4
Direct Student Loans		25.0
Guaranteed-Student Loans (NYDEAC)[a]	131,000	178.0

[a]Includes New York students who used loans in other states.

GOALS FOR HIGHER EDUCATION IN NEW YORK STATE

Quantitative models of the type described in this report require statements of objectives that can be used as the basis for choosing among competing programs and selecting appropriate values for important parameters. Moreover, it must be possible to translate these objectives into quanitative terms.

In recent years the Regents have had three major objectives for higher education in New York State:

1. Achievement of open access to higher education across the state.
2. Maintenance of a comprehensive and diverse higher education system.
3. Maintenance of the quality of higher education programs.

Models for studying financing strategies require translation of these and other similar broad goal statements into quantitative terms. Unfortunately, rules and guidelines for carrying out this translation do not exist and therefore planners and analysts must apply their judgment to this task. Complicating this process is the fact that policy-makers generally do not select objectives independently of their policy implications.

More effective handling of such matters is one of the potential long-term benefits of use of quantitative models in policy development. The objectives chosen for the model, which were chosen to be consistent with Figure 2.2, are described in some detail in the next chapter. The specific form of the objective function was based in part on trial runs of the model in the initial stages of the project.

CHAPTER 3

THE STATE FINANCIAL PLANNING MODEL

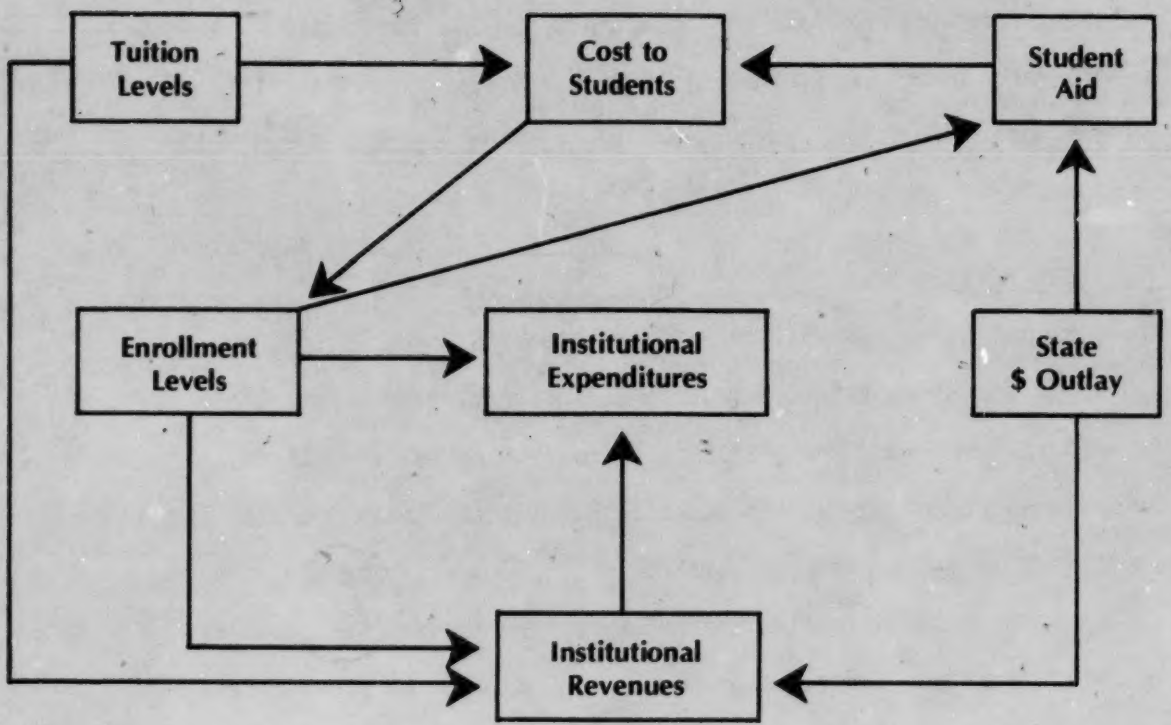
What kind of a model can be developed to assist policymakers to understand postsecondary education better and to formulate more effective policies in this complex environment? Given the simplified description of postsecondary education in New York State in Chapter 2, which questions and issues should such a model address? These questions were at the heart of the project in its initial stages, and the answers dictated the kinds of relationships, parameters, and data that would be developed, assembled, and studied.

The choice was made early in the project to focus on questions related to state-level financing of higher education. It was also decided to use computer software developed by the National Center for Higher Education Management Systems (NCHEMS) as part of their State Planning System project. This permitted consideration of a wide range of possible models, and created the opportunity to develop a model that involves complex relationships and optimization capabilities.

A very simple representation of the basic model is shown in Figure 3.1. It involves seven major components: tuition levels, cost to students, student aid, enrollment levels, institutional expenditures, state outlay, and institutional revenues. This formulation puts into a functional form the actors and decisions shown in Figure 2.2. The arrows in the figure indicate in a qualitative sense the interrelationships and flows that exist among the components.

The State Financial Planning Model permits the study of the interactions among all seven of these basic components in response to such things as

FIGURE 3.1
PRIMARY COMPONENTS OF THE STATE FINANCIAL PLANNING MODEL



changes in tuition levels, new enrollment projections, and different state aid formulas. There have been many studies of each of the seven individual components of this model in New York State and elsewhere. There have even been a few that deal with several of them together, but no previous model has analyzed student demand, institutional expenditures, and state appropriations in the same comprehensive formulation. This is an extremely important feature since it does begin to reflect the complexity of the actual task facing postsecondary planners and policy-makers.

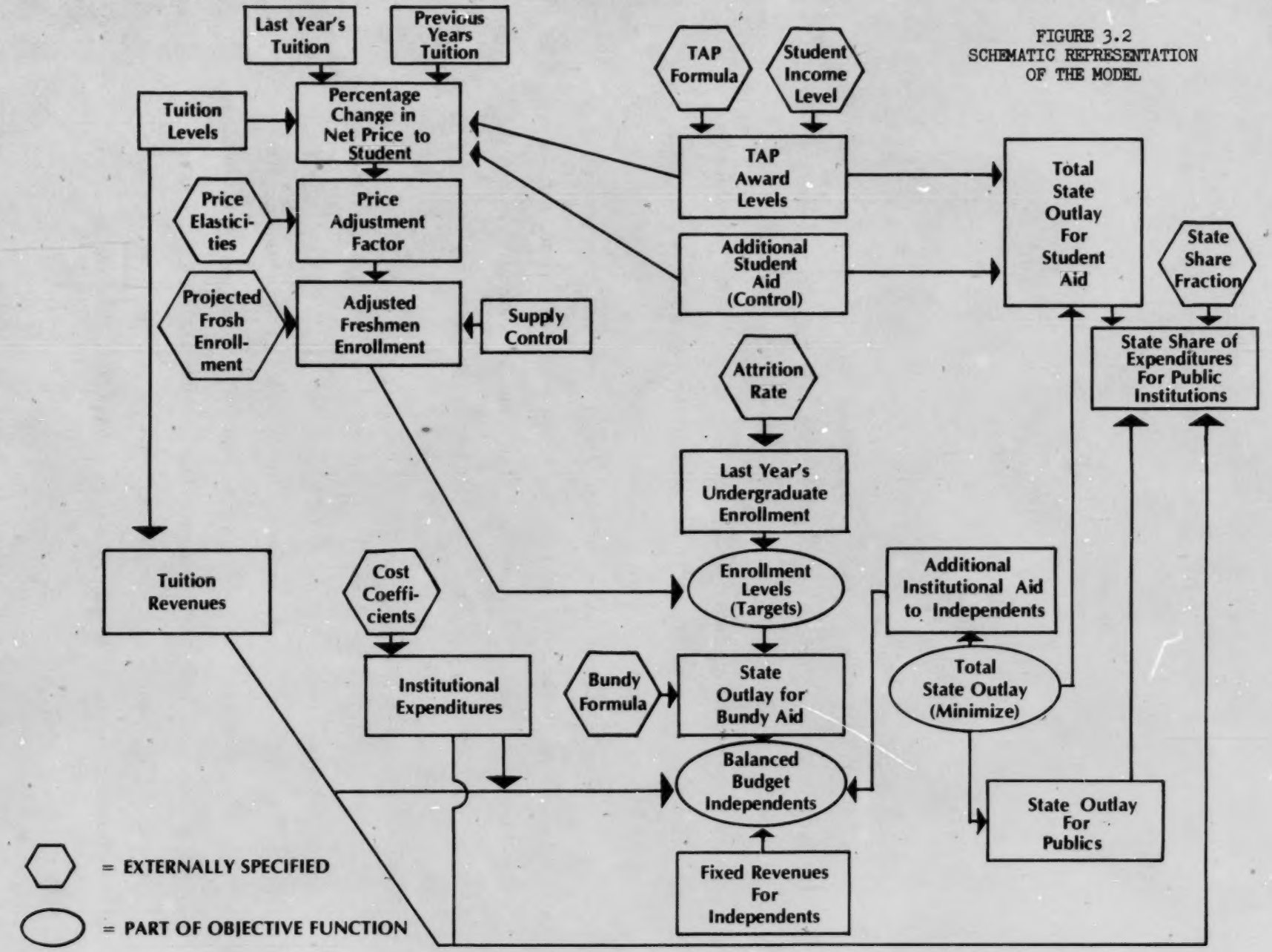
THE BASIC MODEL

Figure 3.1 is not sufficiently detailed and specific to serve as the basis for a quantitative model. Each of the seven components must be augmented and made more explicit to reflect actual situations in New York State and to suggest the specific quantitative relationships and parameters that must be incorporated into the model. Figure 3.2 takes this next step and clarifies the nature of the model. It specifies the kinds of programs, activities, and relationships to be studied; and it paves the way for developing specific quantitative relationships and compiling appropriate data.

Each of the seven major components is described briefly below to indicate the basic relationships and calculations that are involved and to suggest how some of the parts of Figure 3.2 are linked together. A brief discussion of the objective function is also provided. The specific parameters and equations used to transfer this schematic diagram into an actual quantitative model are shown in Appendix A.

In some components of the model, undergraduate student variables are categorized into three income groups. This permits examination of

FIGURE 3.2
SCHEMATIC REPRESENTATION
OF THE MODEL



differential impacts of policies on students in different income categories. The income levels, which refer to gross taxable balances, are:

Income Category	Gross Taxable Balance
HIGH:	$15,000 +
MIDDLE:	$7,500-$14,999
LOW:	$ 0-$7,499

Tuition Levels

Tuition in this model is a control variable (i.e., when the model is run, tuition is free to seek a level that will provide "optimal" results). It includes all standard fees and excludes any tuition waivers and unfunded student aid. This exclusion probably introduces some bias in the computation of net cost to the student, but is realistic in terms of institutional revenues.

Tuition is assumed to be the same for all students in a particular institutional sector regardless of their incomes. This means that any income-related tuition differentials that might be desirable are dealt with in the model by the 'additional student aid' control variable.

Cost to Students

This portion of the model deals only with costs directly related to institutions (e.g., tuition and fees). Since it is the percentage change in net cost that is important in the model, it has been possible to provide rough estimates for some elements of the net cost that in other situations would have to be more accurate. Thus, the cost of room and board, net of Federal student aid and travel costs, have been estimated in the model to be $1500 per full-time undergraduate student. Lack of

data and technical difficulties related to adding more categories of students will hamper attempts to make this component of the model more realistic.

Student Aid

Because of student aid programs in the State, the net tuition price paid by students (i.e., the tuition charge less the Tuition Assistance Program [TAP] award and other awards) is dependent on family income. Student aid in the model includes only TAP, which is computed using the actual formula. Programs for disadvantaged students or loan programs or Federal programs are not included, but could be included in future versions of the model.

TAP awards to full-time undergraduates are computed by reducing the maximum award ($1,500 or tuition, whichever is smaller) by an amount dependent upon income level as shown in Table 2.8 (page 17). The resulting award is then applied to all full-time equivalent students within the given institutional sector and income level using a TAP utilization rate which is essentially the percentage of students receiving TAP. Appendix B provides a more detailed description of the utilization rate. Graduate TAP is currently fixed at $156 in the model, which is the average actual award.

Enrollment Levels

Enrollments are an important part of the model. They are included in the objective function, and a number of features have been incorporated into the model to permit adjustments in enrollments in response to other changes in the system. The base enrollment data are actual, historical figures collected and maintained by the State Education Department for the

years 1969-75. Enrollment projections for future years are those developed by the State Education Department for the Regents 1976 Statewide Plan (Board of Regents, 1976a). For economy of operation, graduate enrollments have been fixed to the target levels in the current versions of the model; thus the model is currently useful only for examining the impacts of factors affecting undergraduate enrollments.

One of the most important features of the model is its capacity to shift enrollments from one institutional sector to another in response to changes in the net prices charged to the students. These shifts are accomplished through the use of price elasticities which are estimates of the impact on enrollment levels of changes in net cost to students. The elasticities are based on a survey of 1974 TAP recipients in New York State. Elasticities for the City University have been assumed to be similar to those for the State University, with some minor adjustments based on an earlier national study (Miller and Radnor, 1975). These elasticities are used in conjunction with the estimates of the percentage change in net price (computed elsewhere) to compute adjustments in the numbers of new freshmen for each of the institutional sectors and years.

Once freshmen are admitted into the system they flow through the system according to historical transition rates, with adjustments based on estimated price sensitivities. The transition rates are based on actual historical student progressions (see Appendix B). Price sensitivity of upperclassmen is assumed to be twenty-five percent of the freshman sensitivity. Although there is no statistical basis for this particular percentage, this was felt to be more realistic than assuming zero sensitivity.

Institutional Expenditures

Estimates of institutional expenditures are based on a simple formula which incorporates fixed and variable cost components (Expenditures = A + B x enrollment). Separate equations have been developed for each institutional sector, and different coefficients have been provided for each type of student.

The coefficients are based on actual expenditure data reported by the institutions. The variable cost coefficients are based on Educational and General expenditures, reduced by items related to capital expenditures and other fixed cost items. An inflation factor has been applied to both the fixed-cost and variable-cost coefficients. The calculations and resulting coefficients are provided in Appendix B.

Institution Revenues

Institutional revenues fall into one of several major categories:

- Tuition and fee income
- Gifts and endowment income
- Grants
- Sponsored programs
- Governmental appropriations
- Additional institutional aid
- Additional student aid.

These revenues are further categorized as either fixed or variable. The major revenues included in the variable component are tuition and fee income, student aid income, and certain forms of governmental appropriations such as "Bundy Aid" which are computable as a function of student enrollment. Bundy Aid is estimated on the basis of baccalaureate degrees

conferred per FTE undergraduate, as well as graduate degrees conferred per FTE graduate. The per-student incremental revenues are applied to the price-adjusted enrollment projections in order to estimate the total variable revenues by institutional sector.

The fixed component of revenue is derived empirically by subtracting these variable revenues from the total revenues for the most recent year for which data existed (1974-75) when the model was developed.

State Outlay

Total state outlay, which is part of the objective function, is computed by summing all of the expenditure/revenue items that are attributable to the State including the five sector appropriations, TAP and Regents Scholarships. It includes only those items that are part of the model, and therefore does not include other major State programs (e.g., health, transportation).

The Objective Function

The objective function in the models provides the basis for optimizing the allocation of resources by the model. It current has four major components:

1) Total full-time undergraduates for each of the five institutional sectors for each year out to 1980-81.
2) Total part-time undergraduates for each of the five institutional sectors for each year out to 1980-81.
3) The budget balance for the independent sector in 1980-81.
4) Net state outlays for student aid and all five sectors for each year out to 1980-81.

The fact that these four factors are relatively independent of each other leads to a model that requires multi-criteria optimization techniques to obtain solutions and to study the impact of alternative policies. Fortunately, an optimization algorithm exists which can cope with problems as complex as this one so that the model can be used to identify the best "negotiated" solution taking into account State, student and institutional factors. For example, the model adjusts institutional enrollments, tuition levels, and other factors in response to changes in state funding patterns.

The optimization mode is not without problems. The user of the model has to specify the relative importance of each element of the objective functions which is done by specifying quantitative tolerance limits or weighting factors for each element of the objective function. These tolerances, which define the relative importance of the different elements in the objective function, introduce a significant requirement for complex value setting by model users. This is particularly true with this model in which the different elements of the objective function are in conflict (that is, being closer to the target on one requires being farther away on another), and where the results of the model can vary significantly depending on the particular tolerances chosen for the different elements of the objective function.

In the models described here, the smaller the tolerance, the more emphasis is placed on attaining the target associated with the associated objective. Implicitly the selection of the tolerance limits for a particular version of the model corresponds to a "negotiation" process between institutions, students, and the State. The selection of target values for the different elements of the objective function also affects

the selection of tolerances. The farther the target is from the current value of the component, the smaller the tolerance required to attain the target.

In practice, the targets and tolerances for the runs described here were developed so that the results of the runs were "reasonable," that is, so that severe fluctuations in enrollments and tuition levels were not observed and unexplainable results did not occur. Chapter 4 discusses in greater detail the targets and tolerances for each major objective.

Constraints

The model in its present form does not reflect all the dynamics of the higher education system. For this reason it has been necessary to provide a variety of constraints in the models to obtain realistic results.

There are two kinds of constraints in the current versions of the model: structural constraints and constraints for realism. The structural constraints include the basic year-to-year flow relationships which constrain enrollment, tuition levels, and institutional expenditures. Thus, for example, the portions of the model that define the relationships between enrollments in one year and the next are structural constraints.

The constraints for realism in the model are included by placing certain parameters and targets in the objective function with a very small tolerance level. This, in effect, constrains the parameter to take on on the target value. Such constraints were incorporated into the model for both independent sector tuition and the TAP ceiling. These had the effect of smoothing out fluctuations in these two factors and keeping increases at realistic levels.

OPERATION OF THE MODEL

The next step in the process of describing the model is to outline briefly the computational sequences. This will complete the description of important aspects of the model and lay the foundation for the discussion of analytical uses of the model.

The model is formulated as an optimization problem in which the decision variables are changed until the stated objectives (i.e., attain enrollment goals, minimize public outlays, and balance the budgets in the independent sector) have been satisfied to the extent possible. Figure 3.3 shows the computational flow of the model, and illustrates the iterative nature of the process. Each of the boxes in the diagram are discussed below:

Set Initial Conditions (Box 1 in Figure 3.3

The first step in any run of the model is to set the initial conditions. This defines the specific problem to be solved and establishes the starting point for the particular run. There are a number of parameters that must be specified in this way including enrollment targets, the coefficients in the expenditure equations, the price response coefficients, the Bundy Aid parameters, the TAP award parameters, the enrollment transition percentages, and tuition levels. Once these have been specified, the actual computations can be started.

Compute Student Aid Levels (Box 2)

In the first iteration of the model, the externally provided tuition levels are used to compute the TAP awards for each institutional sector. The computations are based on the actual TAP award schedule. In subsequent iterations, internally computed tuition levels are used.

Compute Changes in Net Cost to Students (Box 3)

The changes in net cost to students are computed using the current and previous years' values of tuition and student aid. These calculations are performed for students in each of the three income categories.

Compute Adjusted Enrollment Levels (Box 4)

The model next adjusts the number of new entering freshmen in each institutional sector, applying the just-computed percentage change in net cost to student figures to the price elasticities. The calculations are performed for each year under consideration. These counts of new freshmen are then converted into total undergraduate enrollments through the application of a series of externally specified transition probabilities.

Compute Institutional Expenditures and Revenues (Box 5)

Institutional expenditures and revenues are computed by multiplying the adjusted enrollment levels by sets of externally specified expenditure and revenue parameters. The calculations are performed for each year included in the model.

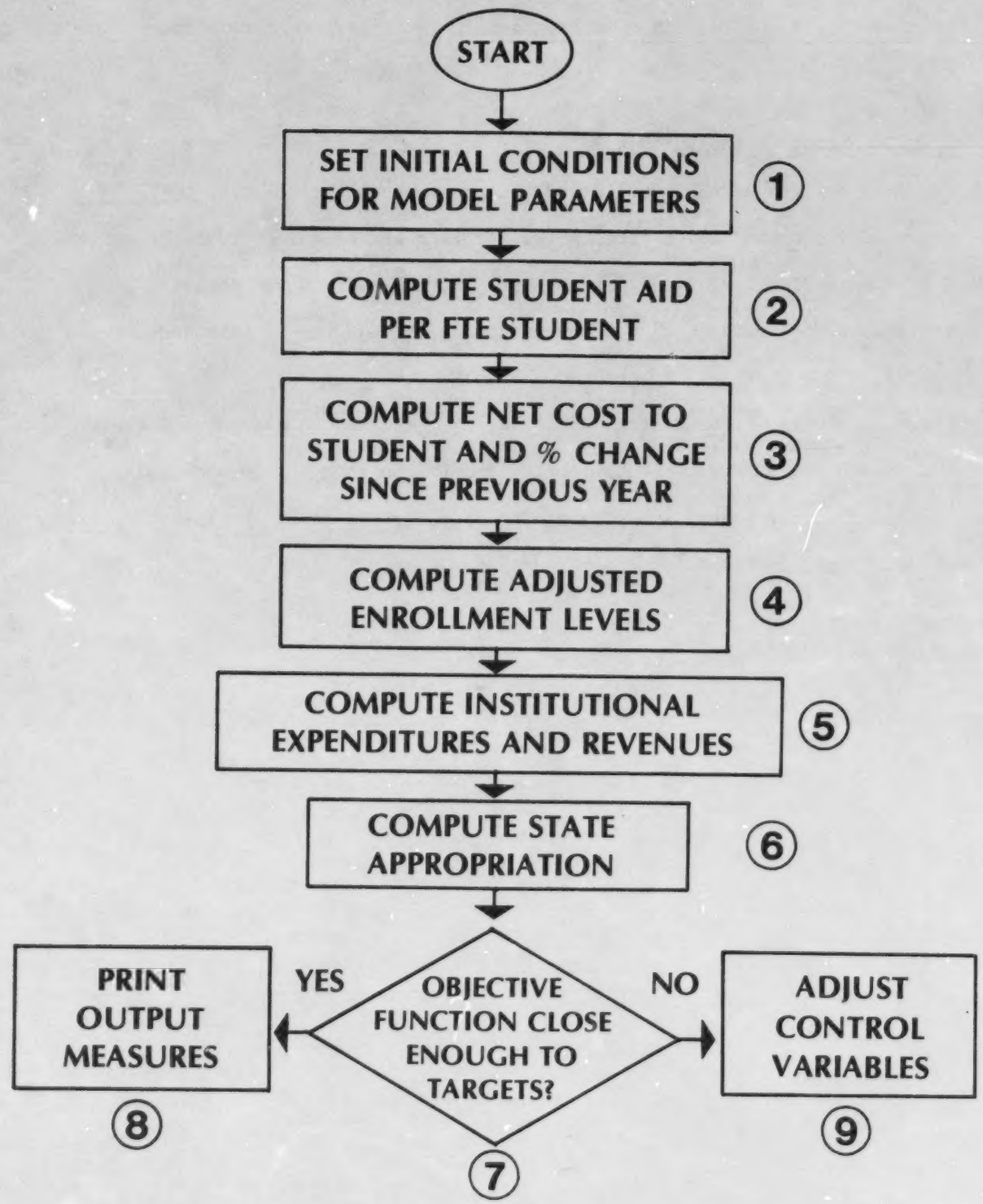
Compute State Appropriation (Box 6)

The State appropriation is then computed by summing all of the individual expenditure items that are funded by the State, including student aid, direct appropriations to the public institutions, and aid to the private institutions. The calculations are performed for each year included in the model.

Check Objective Function (Box 7)

At this point the value of the objective function is computed and evaluated using several technical criteria related to changes in the value

FIGURE 3.3
COMPUTATIONAL PROCEDURE OF THE MODEL



of the objective function to determine if the current solution of the model is acceptable. If it is, the output measures are computed and printed (Box 8). If further improvement in the solution is required, the computations continue.

Adjust Control Variables (Box 9)

The ability of the model to adjust the control variables is the heart of its optimization capability. As long as the value of the objective function is "too large" and improvement is being made in successive iterations, the model will continue to cycle through the computational process. At this stage in the process each of the control variables (tuition levels, institutional aid, etc.) is examined to determine whether a change would improve the solution. Appropriate changes are made using technical criteria that are part of the computer software, and then the computational cycle is begun again at Box 2.

CHAPTER 4

ILLUSTRATIVE APPLICATIONS OF THE MODEL

The important aspects of the model have now been described in general terms, and it is now time to illustrate its use in an actual policymaking context. Three separate questions have been identified for exploration using this model:

1) What is the impact of higher education enrollments and finances of the new tuition policies that went into effect in public institutions in New York State in Fall 1976?

2) What will be the impact of the new legislated Bundy Aid formula?

3) What would be the impact of the new higher education financing strategies suggested in the Regents 1976 Statewide Plan?

The first two of these questions are easy to address. All that is required is a change in a few of the externally specified coefficients related to tuition levels and Bundy Aid awards.

The third question is more difficult, but the aspects of the Regents proposals related to 4-year institutions can be examined without too much difficulty. It is necessary to add a handful of new equations linking public tuition levels and aid to the private sector to State University expenditures. It is also necessary to add an inflation factor to all the expenditure formulas to bring the model into line with current expectations. The financing proposals for the 2-year institutions cannot be addressed without extensive additions to the model because of the complicated local charge-back system that exists in the State.

In order for this or any other planning model to be of value, users must have confidence in the analytical approach. Using the model in a comparative mode should help to foster such confidence. In the comparative mode, a controlled experiment is established: only one parameter (or "policy") is changed between two runs. In this way, errors introduced into the outputs because of inaccuracies in the input data or model relationships will "cancel out" when the two runs are compared. This has the effect of isolating the impact of a given change or policy. The differences between the two runs are probably more accurate than the values in the individual runs.

Based on comparisons with recent historical data, the results provided by the models seem quite accurate. The comparative mode adds even more to the credibility of the results. However, because the results are based in part on the subjective weighting scheme used in the objective function, the results require more scrutiny than do those from most other kinds of models. Bias that may be caused by the weighting scheme is minimized by using the same set of weights for all the runs of the model described in this report.

Despite these difficulties, the model is now approaching a point at which it can assist policy makers in exploring and evaluating alternative policies and courses of action. The model will not "make" the decisions, but it will provide numerical estimates of the impacts of different financing strategies. The results, if carefully considered and interpreted, can provide valuable insights to planners and policymakers.

One final caution is appropriate. Many of the output numbers in the model represent people in the real world. "Students turned away," for example, is a convenient term used by analysts to express unmet

freshman demand. Real students turned away, however, represent dashed anticipations, wasted resources, and accumulating social frustrations. In interpreting the results and acting on them, consideration should be given to these human aspects of the situation.

THE BASIC STRATEGY

The general procedure followed in applying the model is to establish a benchmark run against which subsequent runs can be compared. The benchmark run reflects the continuation of 1975 policies. Subsequent runs are the result of changes in the model that are introduced and examined one at a time so that their effects on enrollments, expenditures, and student costs can be determined. Examining the incremental effect of a particular policy or change on a benchmark run creates a controlled experiment that permits the impact of the policy to be isolated. In such comparisons inaccuracies in input parameters generally cancel out, increasing the utility of the model.

Four basic runs are described below: the benchmark run, two experimental runs for the three policy questions, and a run to test the sensitivity of the model to the rate of inflation. In fact, many more than four runs were made although most of them are not referred to here. Some were failures, but many were interesting in their own right and useful in suggesting further adjustments in the model. It is encouraging to note that the need for repeated runs does diminish with experience in using the model.

In preparing this report the project staff found themselves playing the roles of actual policymakers using the model: evaluating results in the context of decisions made, assessing the outcomes in terms of

real-world practicality and acceptability, and modifying successive runs on the basis of judgment acquired through experience.

It has been necessary on occasion to apply additional constraints, shift priorities, and change parameters in order to obtain useable results. In some cases results have been unrealistic or politically unacceptable (e.g., erratic fluctuations in private sector tuition, large and continuing independent sector budgetary deficits, sharply reduced enrollment of new freshmen). Although in some cases these apparently "unrealistic" outputs may have been demonstrations of the model's capacity to give early warnings of unexpected results, for the most part such results have indicated a need for adjustments. The model forces questions to be asked by the policymaker in the search for politically and socially acceptable outputs. It cannot be emphasized too strongly that the model is merely the extension of a machine, that it seeks mindlessly (and fortunately also tirelessly) to reach its programmed objectives in the most effective, but not always in a politically satisfactory way. This creates a need for monitoring, interpretation, and critical review of the results by persons familiar with the real world of postsecondary education.

The results of the runs described below in critical areas such as level of state expenditures, budgetary deficits, and sector enrollment are generally reasonable and defensible. For that reason it is now possible to say that, to the extent that any quantitative model can, this planning tool is ready for consideration for use in actual policy development and evaluation situations. Readers are encouraged to draw their own conclusions on this matter.

THE OBJECTIVE FUNCTION

The major elements of the objective function are listed below, with a specification of the targets and tolerance limits that have been used in the model described in this chapter.

- Total state expenditures: The target is $1,150 million. This is less than the actual current figure, and its effect is to apply pressure in the model to keep state expenditures at realistic levels. Acceptable deviation (tolerance) from target value was selected to be 10 percent.
- Independent sector, budgetary balances: The target is $15 million cumulative positive balance by 1980-81. The effect of this target is to apply pressure to keep the independent sector operating "in the black." Tolerance, 20 percent.
- Undergraduate Enrollments, by sector: The target for both full- and part-time enrollment targets are derived from the Regents 1976 Statewide Plan for Postsecondary Education (See Appendix B for the actual figures). Their effects are to impose "realistic" constraints on enrollments and to permit evaluation of the impacts of the Regents' enrollment goals. Tolerance, 1 percent.
- Full-Time First-time freshmen, by sector: The targets for these parameters are also derived from Regents 1976 Statewide Plan. This constrains the model from shifting enrollments drastically from year to year. Tolerance, 3 percent.
- First-time freshman enrollment demand fulfillment: The target for this variable is 100 percent. Like the freshman

enrollment target, this helps to maintain enrollments so that financial implications of the Regents' enrollment goals can be evaluated. Tolerance, 3 percent.

Because the tolerances applied to the objective function in this kind of multi-criteria optimization problem can have a significant impact on the results, it is important to mention the process of selecting the weights. The specific targets and weights used in the runs described in this report have been developed through experimentation with the model. The "final" values were selected because they provide "realistic" results. In the analysis of the specific policy questions being addressed, greater emphasis (i.e., smaller tolerance limits) has been placed on the enrollment objectives than on the fiscal objectives. It is difficult to provide a specific rationale for this — or any other — weighting scheme, except that this does make the results more useful in the context of evaluating the Regents' enrollment goals.

It should be noted that graduate enrollments have been fixed to the Regents' goals, enabling the user of the model to concentrate on those factors related to undergraduate enrollments. All other relevant calculations related to graduate enrollments have been performed in the model so that outputs like total expenditures are realistic.

ANALYTICAL RESULTS

In examining the impacts of each of the three policy changes identified above (tuition, "Bundy," Regents' financial strategies), minor adjustments and modifications have been made in the model to reflect the different values for relevant parameters. In the version of the model dealing with the financing strategies proposed by the Regents, changes

have been made to link tuitions to expenditure levels as well as applying the inflation factor to institutional expenditures and revenues. These and other modifications are discussed for each of the runs as appropriate.

Table 4.1 represents a validation of the parameter estimation in the base year (1974-75). Numbers generated for 1974-75 in the Benchmark run are compared to the corresponding actual figures. The actual figures exclude those items not accounted for in the model. Total excluded costs for 1974-75 amount to $79.5 million. A more comprehensive discussion of excluded costs can be found in Appendix B.

The accuracy of the underlying parameter estimation procedures is supported by the closeness of the benchmark figures to the corresponding actual data. The two percent deviation of the total State expenditure from the actual is attributable mainly to slight inaccuracies in the model's appropriation formulas for State University Community Colleges, City University Senior Colleges, and City University Community Colleges. Institutional expenditures are all relatively accurate for the base year, which is to be expected since the expenditure coefficients are based on 1974-75 data.

Table 4.1 also validates the benchmark enrollments. Comparing the benchmark enrollments (1974-75) to the corresponding actuals, we again find only small differences.

For the runs of the different versions of the model, fifty-three report measures are used to describe the postsecondary education system in New York State. These are included in the summary tables for each of the four runs described in detail below. Close scrutiny of these tables should give the reader a clearer understanding of what the model is doing and what the impacts of the policy actions are. The measures

Table 4.1

COMPARISON OF ACTUAL FINANCIAL AND ENROLLMENT DATA WITH BENCHMARK RUN
1974-75

	ACTUAL 1974-75[a]	BENCHMARK 1974-75	DEVIATION FROM ACTUAL (%)
PUBLIC OUTLAYS			
Calculated Total State Expenditures	$1,091.4 million	1,115.3[f]	2.18%
A. State Appropriation			
SUNY-State Operated[e]	632.1 million	632.0	(.02)
SUNY-Community Colleges	75.3 million[b]	79.7	+ 5.84
CUNY-Senior Colleges	167.7 million	172.4	+ 2.80
CUNY-Community Colleges	58.1 million	62.4	+ 7.40
Independent Colleges (BUNDY)	56.9 million	55.4	(2.64)
B. TAP Total	80.8 million[c]	148.4[g]	+83.66
C. Regents Scholarships	24.4 million	22.3	(8.61)
OPERATING BALANCE			
Independent Colleges	($108,267,000)[d]	(140.8)	(22.65)
INSTITUTIONAL EXPENDITURES			
SUNY-State Operated	$713,310,000	$721,400,000	+ 1.13
SUNY-Community Colleges	214,460,000	212,500,000	(.92)
CUNY-Senior Colleges	389,950,000	391,600,000	+ .42
CUNY-Community Colleges	165,760,000	166,400,000	+ .38
Independent Colleges	1,788,610,000	1,840,800,000	+ 2.91
FULL-TIME FIRST-TIME FRESHMEN DEMAND FULFILLMENT (%)	100%	100%	
ENROLLMENT SUMMARIES			
A. Total Full-Time Equivalent (Graduate and Undergraduate)	710,619	703,800	(.96)%
SUNY-State Operated	149,212	148,200	(.68)
SUNY-Community Colleges	105,007	103,200	(1.73)
CUNY-Senior Colleges	128,100	128,700	+ .46
CUNY-Community Colleges	66,500	64,400	(3.16)
Independent Colleges	261,800	259,400	(.92)
B. Undergraduate Enrollment[h]			
SUNY-State Operated[i]			
Full-Time	115,536	117,100	+ 1.35
Part-Time	23,529	23,500	(.13)
SUNY-Community Colleges			
Full-Time	72,557	71,500	(1.46)
Part-Time	63,238	63,200	(.07)
CUNY-Senior Colleges			
Full-Time	87,220	887,900	+ .77
Part-Time	49,382	49,400	+ .03
CUNY-Community Colleges			
Full-Time	43,938	44,200	+ .59
Part-Time	40,428	40,400	(.07)
Independent Colleges			
Full-Time	176,255	173,800	(1.40)
Part-Time	55,325	55,300	(.05)
Total Full-Time Undergraduates	495,506	494,500	(.21)
Total Part-Time Undergraduates	231,902	231,900	(.01)

[a] State Education Department, 1976.

[b] State University of New York, 1975a.

[c] State Education Department, 1975b.

[d] Postsecondary Information Systems, HEDS.

[e] Net of "income offset".

[f] Net of TAP overstatement.

[g] Fully phased in with New TAP formula.

[h] Exclusions: SUNY-4 year excludes specialized, health science centers and statutory. Independent excludes health sciences, seminaries, and two-year degree-program institutions.

[i] Includes Ag. & Tech.

reported in the tables are only a small subset of the available output generated by the computer software. Policy-makers could obtain additional measures to obtain greater detail in their area of interest. For example, additional measures could be graduate level tuition and net costs, state expenditure per student, average Bundy Aid by degree level, and so forth.

The "Benchmark" Run

Early in 1976 several important decisions related to higher education were enacted into law in New York State: to impose tuition at the City University, to increase tuition at the State University, and to increase the payment schedule of "Bundy" aid to the independent sector. Also in 1976 the Regents developed a new set of enrollment projections which were intended to reflect more accurately the impact of the impending decline of numbers of high school graduations, a depressed state economy and an uncertain college-going rate.

Table 4.2 shows the results of the benchmark run which reflects "the world of 1975-76." This version of the model retains the 1975-76 Bundy formula and public tuition levels through 1980-81. As in all subsequent versions of the model, the first year for which calculations are made is 1974-75, because this is the most recent year for which actual financial data were available when the runs were made.

Noteworthy in the benchmark run is the attainment of the enrollment objectives for full-time undergraduates by 1979-80 as well as balancing the budget in the independent sector. Total state expenditures move steadily but gradually upward after 1975, at a rate of one to five percent per year, reaching $1.46 billion by 1980. All components of total state

Table 4.2
SELECTED OUTPUT STATISTICS FROM BENCHMARK RUN
(Old Tuition; Old Bundy Formula; 4 Percent Inflation)

	1974-75 (000,000)	1975-76 (000,000)	1976-77 (000,000)	1977-78 (000,000)	1978-79 (000,000)	1979-80 (000,000)	1980-81 (000,000)
PUBLIC OUTLAYS							
TOTAL STATE EXPENDITURES ($ Millions)	$1,175.1	$1,253.9	$1,266.3	$1,299.0	$1,343.5	$1,400.0	$1,463.0
A. State Appropriation							
SUNY-State Operated[a]	$ 632.0	$ 680.8	$ 697.6	$ 731.9	$ 770.4	$ 810.6	$ 859.3
SUNY-Community Colleges	79.7	89.9	97.7	103.3	107.2	110.1	115.2
CUNY-Senior Colleges	172.4	179.9	162.7	149.0	140.5	151.3	161.4
CUNY-Community Colleges	62.4	65.5	67.2	70.6	79.2	82.9	84.3
Independent Colleges (BUNDY)	55.4	57.4	59.6	62.1	63.0	64.0	63.6
B. TAP Total[b]	$ 148.4	$ 154.8	$ 156.3	$ 157.3	$ 158.6	$ 156.5	$ 154.9
C. Regents Scholarships	$ 22.3	$ 23.1	$ 22.6	$ 22.2	$ 22.1	$ 21.9	$ 21.8
ACCUMULATED OPERATING BALANCE ($ Millions)							
Independent Colleges	$ (140.8)	$ (220.1)	$ (244.4)	$ (214.6)	$ (137.4)	$ (83.0)	$ 24.3
INSTITUTIONAL EXPENDITURES ($ Millions)							
SUNY-State Operated[c]	$ 721.4	$ 777.0	$ 789.1	$ 824.3	$ 864.4	$ 906.2	$ 958.1
SUNY-Community Colleges[c]	212.5	239.5	260.6	275.4	285.7	293.6	307.1
CUNY-Senior Colleges[c]	391.6	402.2	359.5	328.7	310.0	332.6	353.6
CUNY-Community Colleges[c]	166.4	174.6	179.2	188.3	211.1	221.2	224.9
Independent Colleges	1,840.8	1,963.4	2,096.8	2,200.9	2,315.3	2,397.6	2,478.3
PERCENT OF FULL-TIME FIRST-TIME FRESHMEN ENROLLED	100 %	100 %	72.5%	76.7%	81.1%	92.9%	91.6%
ENROLLMENT SUMMARIES							
A. Total Full-Time Equivalent (Graduate and Undergraduate)	703,800	733,000	720,800	712,000	712,100	713,000	714,300
SUNY-State Operated	148,200	157,200	150,100	151,100	153,000	154,800	159,100
SUNY-Community Colleges	103,200	112,300	117,700	119,700	119,400	117,900	118,600
CUNY-Senior Colleges	128,700	128,900	109,100	93,100	81,900	85,100	87,400
CUNY-Community Colleges	64,400	65,100	64,100	64,800	70,500	71,000	69,300
Independent Colleges	259,400	269,600	279,700	283,300	287,300	284,100	279,900
B. Undergraduate Enrollment							
SUNY-State Operated							
Full-Time	117,100	124,200	115,700	116,100	117,200	118,600	122,300
Part-Time	23,500	25,800	27,500	27,900	28,600	28,600	28,800
SUNY-Community Colleges							
Full-Time	71,500	75,500	80,800	82,000	81,200	79,400	79,600
Part-Time	63,200	73,600	74,000	75,600	76,500	77,000	78,200
CUNY-Senior Colleges							
Full-Time	87,900	89,900	74,600	61,800	53,500	55,300	57,600
Part-Time	49,400	51,000	48,700	42,800	37,300	39,400	38,800
CUNY-Community Colleges							
Full-Time	44,200	43,700	45,400	47,200	51,000	50,500	47,800
Part-Time	40,400	42,700	37,400	35,300	39,000	41,000	43,000
Independent Colleges							
Full-Time	173,800	180,100	18 ,200	186,700	188,100	183,200	177,300
Part-Time	55,300	60,300	63,900	66,700	67,700	68,600	69,500
Total Full-Time Undergraduates	494,500	513,400	501,600	493,800	490,900	487,000	484,500
Target FTUG	495,500	525,900	509,700	498,000	496,900	487,100	484,600
Total Part-Time Undergraduates	231,900	253,300	251,300	248,200	249,100	254,600	258,200
Target PTUG	231,900	253,300	251,300	248,200	249,100	254,500	258,000
STUDENT PRICE SUMMARIES							
SUNY-State Operated							
Tuition/Full-Time Undergraduate	710	710	710	710	710	710	710
Net Price/Full-Time Undergraduate[d]							
High Income	610	610	610	610	610	610	610
Middle Income	215	215	215	215	215	215	215
Low Income	0	0	0	0	0	0	0
SUNY-Community Colleges							
Tuition/Full-Time Undergraduate	570	570	570	570	570	570	570
Net Price/Full-Time Undergraduate[d]							
High Income	470	470	470	470	470	470	470
Middle Income	215	215	215	215	215	215	215
Low Income	0	0	0	0	0	0	0
CUNY-Senior Colleges							
Tuition/Full-Time Undergraduate	160	160	160	160	160	160	160
Net Price/Full-Time Undergraduate[d]							
High Income	160	160	160	160	160	160	160
Middle Income	160	160	160	160	160	160	160
Low Income	160	160	160	160	160	160	160
CUNY-Community Colleges							
Tuition/Full-Time Undergraduate	160	160	160	160	160	160	160
Net Price/Full-Time Undergraduate[d]							
High Income	160	160	160	160	160	160	160
Middle Income	160	160	160	160	160	160	160
Low Income	160	160	160	160	160	160	160
Independent Colleges							
Tuition/Full-Time Undergraduate	2,871	3,041	3,024	3,309	3,417	3,240	3,332
Net Price/Full-Time Undergraduate[d]							
High Income	2,121	2,291	2,454	2,559	2,667	2,490	2,582
Middle Income	1,586	1,756	1,919	2,024	2,132	1,955	2,047
Low Income	1,371	1,541	1,704	1,807	1,917	1,740	1,832

[a] Net of "income offset".

[b] Fully phased in with new TAP formula.

[c] Net of debt service.

[d] Tuition less TAP: for TAP-recipients only.

expenditures including sector appropriations, "Bundy" aid, Tuition Assistance Program (TAP) and Regents Scholarships contribute to this increase.

The accumulated deficit of the independent sector reaches a maximum of $244 million in 1976-77. Then, the deficit is turned into a surplus of $24 million by 1980-81.

The independent sector tuition changes from year to year in response to pressures to balance the budget in that sector. A constraint has been applied to the independent sector tuition to smooth out fluctuations, because most policy makers would prefer a tuition policy which increases monotonically. It is interesting to note that in 1979-80 the tuition level in the independent sector declines slightly. This suggests that current financing strategies may provide sufficient support to permit both stabilizing tuitions and balanced budgets in the independent sector. Because the independent sector budget is almost balanced by 1979-80, the model "works harder" to minimize tuition levels.

Tuition in the public sector does not change because of insufficient pressure to minimize total state expenditures. Different weights could be used to simulate an austerity budget in which case the model would adjust public tuition levels upward accordingly.

An additional run (not summarized in detail) with no inflation factor was made to assess the impact of inflation. In this run, enrollments are higher and tuition levels lower at the end of the planning horizon. This suggests that the budget in the independent sector will be easier to

balance in an environment of inflation. This conclusion was further supported by another run using a 6 percent inflation rate.

Tuition Implementation Run

The first of the three experimental runs provides a means for estimating the effect of increasing public sector tuition and Bundy aid for the independent sector. The impact is measured in terms of state-level expenditures, the financial situation in the independent sector, enrollments, and student costs. Table 4.3 provides basic statistics relevant to this run.

The most significant impacts of the tuition and Bundy aid increases as shown in Table 4.3 are changes in total state expenditures, total TAP expenditures, and independent sector tuition rates. The new policies start in 1976-77 and there is an increase in total state expenditures over the benchmark run from that year out to 1980-81. Increased tuition revenue of $16.5 million in SUNY-State Operated is offset by additional TAP payments of $5.5 million - leaving a net decrease in state expenditures of $11.1 million.

Imposition of tuition at CUNY-Senior Colleges yields increased tuition revenues of $67.3 million. This increases TAP by $28.4 million. The resulting net decrease in appropriation required is not fully realized by the State, however, because of the funding formula for the City University (50/50 State/City shares of net operating budget). Increases for total state expenditures from 1976-77 on can also be attributed to increased TAP payments for students attending community colleges. Because of the funding formulas for community colleges, the state does not benefit from increased tuition revenues at such schools.

Table 4.3
SELECTED OUTPUT STATISTICS FROM "TUITION RUN"
(New Tuition; New Bundy Formula; 4 Percent Inflation)

	1974-75 (000,000)	1975-76 (000,000)	1976-77 (000,000)	1977-78 (000,000)	1978-79 (000,000)	1979-80 (000,000)	1980-81 (000,000)
PUBLIC OUTLAYS							
TOTAL STATE EXPENDITURES ($ Millions)	$1,175.1	$1,253.9	$1,273.1	$1,306.8	$1,353.0	$1,409.0	$1,471.3
A. State Appropriation							
SUNY-State Operated[a]	$ 632.0	$ 680.8	$ 681.1	$ 715.2	$ 753.6	$ 793.7	$ 842.1
SUNY-Community Colleges	79.7	89.8	97.7	103.3	107.2	110.1	115.2
CUNY-Senior Colleges	172.4	179.9	129.19	120.6	115.9	125.7	135.1
CUNY-Community Colleges	62.4	65.5	67.2	70.6	79.2	82.9	84.3
Independent Colleges (BUNDY)	55.4	57.4	66.7	69.5	70.4	71.5	71.0
B. TAP Total[b]	$ 148.4	$ 154.8	$ 206.1	$ 202.8	$ 202.1	$ 200.6	$ 199.3
C. Regents Scholarships	$ 22.3	$ 23.1	$ 22.6	$ 22.2	$ 22.1	$ 21.9	$ 21.8
ACCUMULATED OPERATING BALANCE ($ Millions)							
Independent Colleges	$ (140.8)	$ (220.1)	$ (237.5)	$ (201.0)	$ (120.0)	$ (76.8)	$ 22.6
INSTITUTIONAL EXPENDITURES ($ Millions)	$ 721.						
SUNY-State Operated[c]	$ 721.4	$ 777.0	$ 789.2	$ 824.2	$ 864.4	$ 906.3	$ 958.5
SUNY-Community Colleges[c]	212.5	239.5	260.6	275.4	285.8	293.7	307.1
CUNY-Senior Colleges[c]	391.6	402.2	359.5	328.7	310.0	332.6	353.6
CUNY-Community Colleges[c]	166.4	174.6	179.2	188.3	211.1	221.0	224.9
Independent Colleges	1,840.8	1,963.4	2,096.8	2,200.9	2,315.3	2,397.7	2,478.6
PERCENT OF FULL-TIME FIRST-TIME FRESHMEN ENROLLED	100 %	100 %	72.5%	76.7%	81.1%	92.9%	91.7%
ENROLLMENT SUMMARIES							
A. Total Full-Time Equivalent (Graduate and Undergraduate)	703,800	733,000	720,800	712,000	712,000	713,000	714,400
SUNY-State Operated	148,200	157,200	150,200	151,000	153,000	154,900	159,200
SUNY-Community Colleges	103,200	112,300	117,700	119,700	119,500	118,000	118,700
CUNY-Senior Colleges	128,700	128,900	109,100	93,100	81,900	85,100	87,400
CUNY-Community Colleges	64,400	65,100	64,100	64,800	70,500	71,000	69,300
Independent Colleges	259,400	269,600	279,700	283,300	287,300	284,100	280,000
B. Undergraduate Enrollment							
SUNY-State Operated							
Full-Time	117,100	124,200	115,700	116,100	117,200	118,600	122,400
Part-Time	23,500	25,800	27,500	27,900	28,600	28,600	28,800
SUNY-Community Colleges							
Full-Time	71,500	75,500	80,800	82,000	81,200	79,500	79,600
Part-Time	63,200	73,600	74,000	75,600	76,600	77,000	78,200
CUNY-Senior Colleges							
Full-Time	87,900	89,900	74,600	61,900	53,500	55,300	57,600
Part-Time	49,400	51,000	48,700	42,800	37,300	39,400	38,800
CUNY-Community Colleges							
Full-Time	44,200	43,700	45,400	47,200	51,000	50,500	47,800
Part-Time	40,400	42,700	37,400	35,300	39,000	41,000	43,000
Independent Colleges							
Full-Time	173,800	180,100	185,200	186,700	188,100	183,200	177,400
Part-Time	55,300	60,300	63,900	66,700	67,700	68,700	69,500
Total Full-Time Undergraduates	494,500	513,400	501,600	293,800	490,900	487,000	484,700
Target FTUG	485,900	525,900	509,700	498,000	496,900	487,100	484,600
Total Part-Time Undergraduates	231,900	253,300	251,300	248,200	249,100	254,700	258,200
Target PTUG	231,900	253,300	251,300	248,200	249,100	254,500	258,000
STUDENT PRICE SUMMARIES							
SUNY-State Operated							
Tuition/Full-Time Undergraduate	710	710	810	810	810	810	810
Net Price/Full-Time Undergraduate[d]							
High Income	610	610	710	710	710	710	710
Middle Income	215	215	215	215	215	215	215
Low Income	0	0	0	0	0	0	0
SUNY-Community Colleges							
Tuition/Full-Time Undergraduate	570	570	670	670	670	670	670
Net Price/Full-Time Undergraduate[d]							
High Income	470	470	570	570	570	570	570
Middle Income	215	215	215	215	215	215	215
Low Income	0	0	0	0	0	0	0
CUNY-Senior Colleges							
Tuition/Full-Time Undergraduate	160	160	835	835	835	835	835
Net Price/Full-Time Undergraduate[d]							
High Income	160	160	735	735	735	735	735
Middle Income	160	160	215	215	215	215	215
Low Income	160	160	0	0	0	0	0
CUNY-Community Colleges							
Tuition/Full-Time Undergraduate	160	160	775	775	775	775	775
Net Price/Full-Time Undergraduate[d]							
High Income	160	160	675	675	675	675	675
Middle Income	160	160	215	215	2159	215	215
Low Income	160	160	0	0	0	0	0
Independent Colleges							
Tuition/Full-Time Undergraduate	2,871	3,041	3,203	3,306	3,404	3,174	3,277
Net Price/Full-Time Undergraduate[d]							
High Income	2,121	2,291	2,453	2,556	2,654	2,424	2,527
Middle Income	1,586	1,756	1,918	2,021	2,119	1,889	1,992
Low Income	1,371	1,541	1,703	1,806	1,904	1,674	1,777

[a] Net of "income offset".

[b] Fully phased in with new TAP formula.

[c] Net of debt service.

[d] Tuition less TAP; for TAP-recipients only.

The additional TAP (in 1976-77) for the SUNY Community Colleges is $12.6 million.

Total TAP expenditures increased $49.8 million (in 1976-77) over the corresponding benchmark figure. This increased state expenditure, as mentioned above, is offset by reduced state appropriations because of increased tuition revenues of $50.2 million. Hence, the net increase in total state expenditures of $6.8 million for 1976-77 can be considered attributable primarily to the $7.1 million increase in Bundy aid. The same holds true for comparable figures through 1980-81.

Despite the fact that enrollment shifts between the benchmark and the tuition runs were insignificant, there are some interesting fiscal impacts. The balancing of the independent sector budget is facilitated by the increased Bundy payments. This in turn relieves the pressure on independent sector tuition by 1978-79 and we observe significantly lower tuition as compared to the benchmark run. For 1978-79 through 1980-81, we find tuition differences of $13, $66, and $55 (.4 percent, 2.0 percent, 1.7 percent). Increased Bundy payments for 1978-79 through 1980-81 of $21.5 million appear to give the independent sector the impetus to decrease tuition levels by $27.4 million over the same three-year period. The results suggest that a balanced budget situation may be restored in the independent sector within a few years without the need for constant increases in tuition, an important finding if it is true.

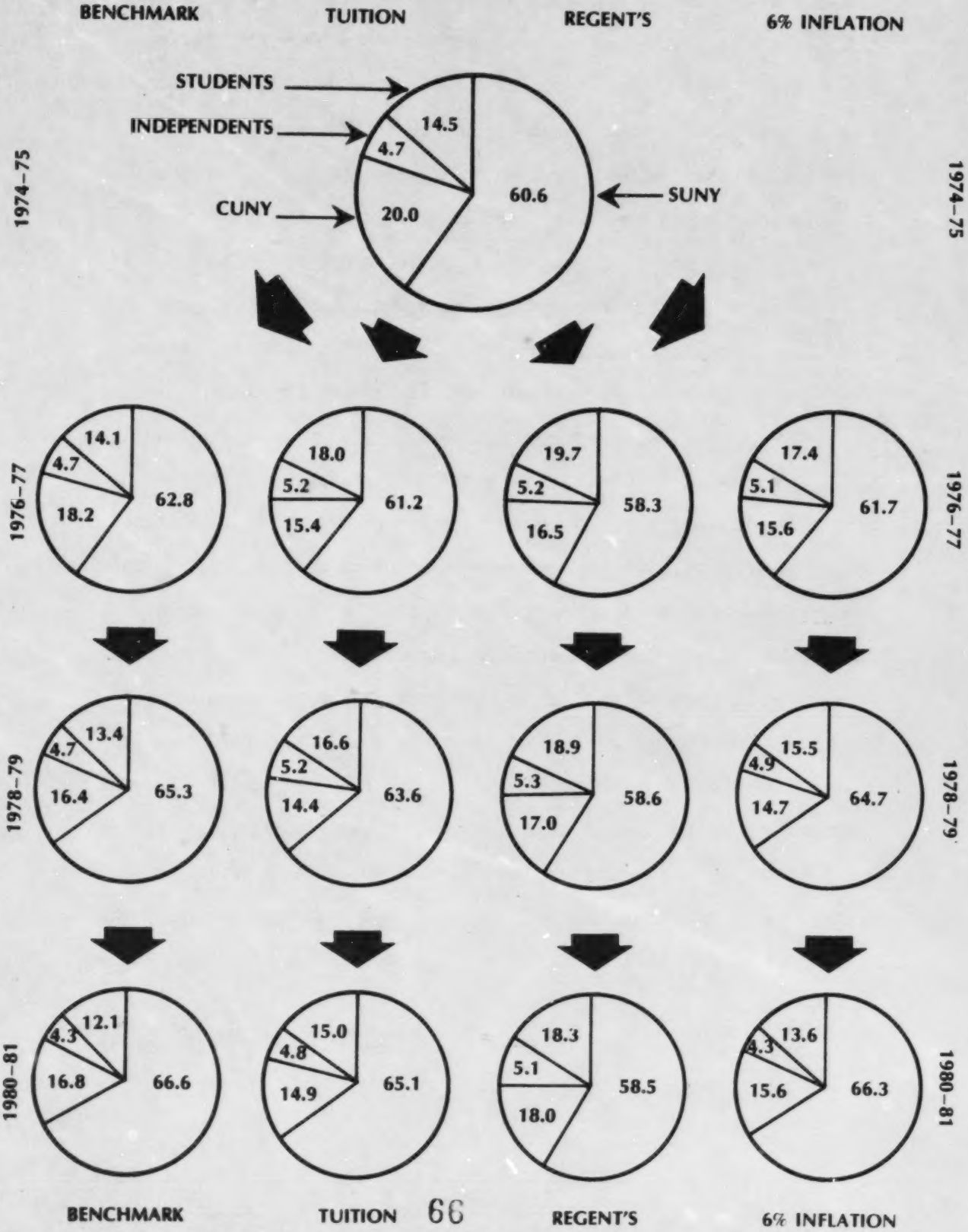
The model as presently designed does not project significant inter-sector student migration in response to tuition changes, or increases in "Bundy" aid. There is not even a slight shift, for example, from the CUNY senior colleges due to imposition of tuition, to the independent sector as the independent institutions (presumably) become better able

to offer student financial assistance. This appears to be a weakness in the model. The 1976-77 tuition increases - which are $100 at SUNY and approximately $675 and $615 at CUNY Senior and Community Colleges respectively - undoubtedly would have some noticeable impact on enrollments. Much of this impact, however, is already taken into account in the Regents' enrollment expectations which are used as input to the model. It is no coincidence that these enrollment figures are very close to the Regents enrollment projections. In this formulation of the model, the Regents projections were used as the targets in the objective function. Unfortunately, this masks the impact of the tuition increase. The model was left this way because preliminary enrollment reports indicated that the Regents projections were quite accurate for Fall 1976, and the price elasticities cannot by themselves explain all of the actual enrollment shift. The new admissions policies, etc. instituted by the City University also must be accounted for in this way. By forcing the enrollments to these levels it is possible to gauge the fiscal implications of the Regent's enrollment projections.

It is interesting to note the differential impact on students of different income levels. High income students at the State University absorb the entire $100 tution increase, while high income City University students absorb $575 out of $675 increase. Because of TAP, moderate and low income State University students are not as severely affected. Some moderate and low income City University College students actually "make money" due to TAP, because the former $110 fee has now been included in the tuition.

Figure 4.1 illustrates how the Tuition run changes the distribution of state expenditures in selected years. The decreases at the City

FIGURE 4.1
PERCENTAGE DISTRIBUTION OF STATE EXPENDITURES ON HIGHER EDUCATION
FOR FOUR RUNS OF STATE FINANCIAL PLANNING MODEL



University reflect the increased tuition, while the increases for students reflect increased TAP expenditures. A further pictorial effect of increases is seen in Figure 4.2. This bar chart gives the percentage differences in five selected measures for three pairs of runs.

Regents Finance Strategy Runs

In their 1976 Tentative Statewide Plan, the Board of Regents made a number of recommendations to provide a new strategy for the allocation of funds among the sectors of higher Education (Board of Regents, 1976a, pp 81-84). Briefly stated, they were as follows:

— Tuition levels for full-time undergraduates at public colleges should equal one-third of the cost of education.

— The state's share of the cost of operating the City University senior colleges, less tuition revenues, should reach 80 percent by 1979-80.

— Total state aid - student and institutional - for the independent sector should equal 25 percent of the "standard cost" per undergraduate multiplied by the number of undergraduates in the independent sector. The relative distribution of funds for student aid and institutional support should be in the ratio of 2:1 for undergraduates.

These relationships have been built into the basic model structure so the impact of these proposed strategies can be estimated. The 4 percent inflation factor has been retained for all cost and expenditure-related calculations in order to observe the effect of inflation on the tuition variables.

FIGURE 4.2
PERCENTAGE DIFFERENCES IN VALUES OF SELECTED PARAMETERS
BETWEEN PAIRS OF RUNS OF THE MODEL

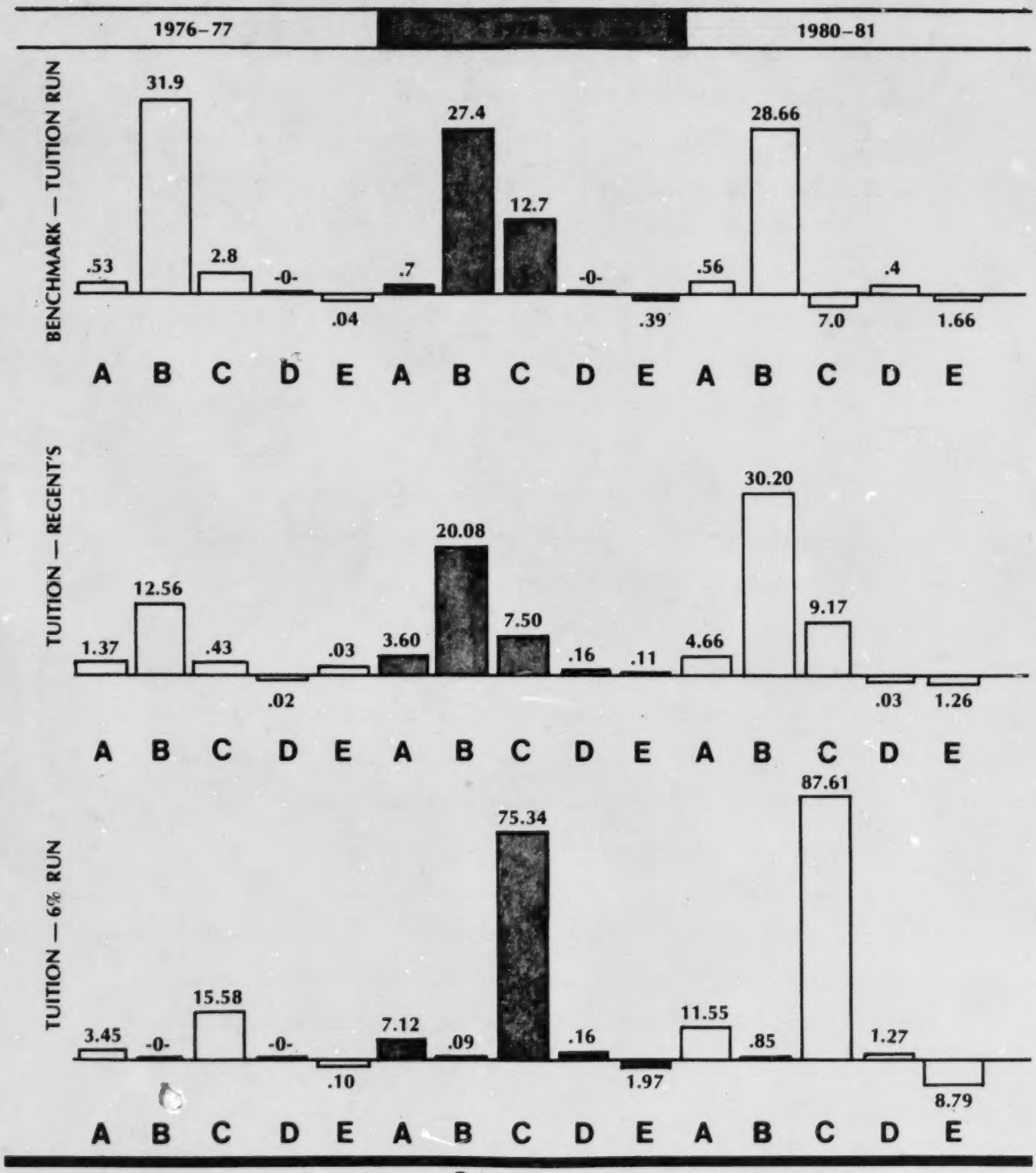


Table 4.4 shows the results of the "Regent's Run," which should be compared with the Tuition Run (Table 4.3).

The impact of the Regents Financing strategies versus the existing 1976-77 policies can be isolated because only those variables related to the Regent's strategies have been changed between the two runs. The most significant impact of the new financing strategies is a one percent increase in the annual growth rate of total state expenditures (i.e., approximately 4 1/2 percent per year for the Regent's Run versus approximately 3 1/2 percent for the Tuition-Bundy run). In dollar terms the total state expenditures for the Regents run are a $17.5 million and $68.7 million higher than for the Tuition run for 1976-77 and 1980-81, respectively. Potentially more important is the shift in the distribution of state funds. Figure 4.1 depicts these percentages for the Regent's Run for selected years. Compared to the Tuition run the percentage share of total state expenditures going to students is larger (18.3 percent versus 15.0 percent) while the share going to the State University is smaller (52.5 percent versus 65.1 percent) and the share going to the City University is larger (18 percent versus 14.9 percent).

The estimated total state appropriation for postsecondary education is supplied in the Regents' 1976 Statewide Plan (Board of Regents, 1976a, p. 89) indicates that the model is realistic. Table 4.5, which compares the projections in the Plan to those in the Planning Model, shows consistently small percentage differences.

The Regents run results in an annual increase in public sector levels at a rate equal to the inflation rate. These increases in tuition cause State expenditures for TAP to increase significantly ($26 million in 1976-77).

Table 4.4
SELECTED OUTPUT STATISTICS FROM "REGENTS RUN"
(Regents Financing Strategy Implemented; 4 Percent Inflation)

	1974-75 (000,000)	1975-76 (000,000)	1976-77 (000,000)	1977-78 (000,000)	1978-79 (000,000)	1979-80 (000,000)	1980-81 (000,000)
PUBLIC OUTLAYS							
TOTAL STATE EXPENDITURES ($ Millions)	$1,175.1	$1,253.9	$1,290.6	$1,334.4	$1,401.8	$1,472.0	$1,540.0
A. State Appropriation							
SUNY-State Operated[a]	$ 632.0	$ 680.8	$ 654.7	$ 682.4	$ 713.5	$ 745.8	$ 785.3
SUNY-Community Colleges	79.7	89.8	97.7	103.3	107.9	110.0	115.1
CUNY-Senior Colleges	172.4	180.0	146.3	145.9	159.2	181.4	192.4
CUNY-Community Colleges	62.4	65.5	67.2	70.6	79.2	82.8	84.5
Independent Colleges (BUNDY)	55.4	57.4	67.4	71.9	74.7	77.7	78.8
B. TAP Total[b]	$ 148.4	$ 154.8	$ 232.0	$ 235.5	$ 242.7	$ 249.9	$ 259.5
C. Regents Scholarships	$ 22.3	$ 23.1	$ 22.6	$ 22.2	$ 22.1	$ 21.9	$ 21.8
ACCUMULATED OPERATING BALANCE ($ Millions)							
Independent Colleges	$ (140.8)	$ (220.1)	$ (236.5)	$ (197.4)	$ (111.0)	$ (71.8)	$ 23.8
INSTITUTIONAL EXPENDITURES ($ Millions)							
SUNY-State Operated[c]	$ 721.4	$ 777.0	$ 788.8	$ 824.2	$ 864.3	$ 906.0	$ 958.3
SUNY-Community Colleges[c]	212.5	239.5	260.6	275.4	287.7	293.4	307.0
CUNY-Senior Colleges[c]	391.6	402.2	359.5	328.7	310.0	332.5	353.5
CUNY-Community Colleges[c]	166.4	174.6	179.2	188.3	211.1	220.7	225.3
Independent Colleges	1,840.8	1,963.4	2,096.8	2,200.9	2,315.3	2,397.0	2,478.2
PERCENT OF FULL-TIME FIRST-TIME FRESHMEN ENROLLED	100 %	100 %	72 %	77 %	81 %	93 %	92 %
ENROLLMENT SUMMARIES							
A. Total Full-Time Equivalent (Graduate and Undergraduate)	703,800	733,000	720,600	712,000	712,900	712,500	714,300
SUNY-State Operated	148,200	157,200	150,000	151,000	152,900	154,800	159,100
SUNY-Community Colleges	103,200	112,300	117,700	119,700	120,300	117,800	118,600
CUNY-Senior Colleges	128,700	128,900	109,100	93,100	81,900	85,100	87,400
CUNY-Community Colleges	64,400	65,100	64,100	64,800	70,500	70,900	69,400
Independent Colleges	259,400	269,600	279,700	283,300	287,300	283,900	279,900
B. Undergraduate Enrollment							
SUNY-State Operated							
Full-Time	117,100	124,200	115,600	116,100	117,100	118,500	122,300
Part-Time	23,500	25,800	27,500	27,900	28,600	28,600	28,300
SUNY-Community Colleges							
Full-Time	71,500	75,500	80,800	82,000	82,000	79,300	79,500
Part-Time	63,200	73,600	74,000	75,600	76,500	77,000	78,200
CUNY-Senior Colleges							
Full-Time	87,900	89,900	74,600	61,900	53,500	55,300	57,600
Part-Time	49,400	51,000	48,700	42,800	37,300	39,400	38,800
CUNY-Community Colleges							
Full-Time	44,200	43,700	45,400	47,200	51,000	50,400	47,900
Part-Time	40,400	42,700	37,400	35,300	39,000	41,000	43,000
Independent Colleges							
Full-Time	173,800	180,100	185,200	186,700	188,100	183,000	177,300
Part-Time	55,300	60,300	63,900	66,700	67,700	68,700	69,500
Total Full-Time Undergraduates							
Target FTUG	494,500	513,400	501,500	493,800	491,700	486,500	484,600
Total Part-Time Undergraduates							
Target PTUG	231,900	253,300	251,300	248,200	249,100	254,700	258,200
STUDENT PRICE SUMMARIES							
SUNY-State Operated							
Tuition/Full-Time Undergraduate	710	710	968	1,007	1,047	1,089	1,133
Net Price/Full-Time Undergraduate[d]							
High Income	610	610	750	750	750	750	750
Middle Income	215	215	215	215	215	215	215
Low Income	0	0	0	0	0	0	0
SUNY-Community Colleges							
Tuition/Full-Time Undergraduate	570	570	828	867	907	949	993
Net Price/Full-Time Undergraduate[d]							
High Income	470	470	728	750	750	750	750
Middle Income	215	215	215	215	215	215	215
Low Income	0	0	0	0	0	0	0
CUNY-Senior Colleges							
Tuition/Full-Time Undergraduate	160	160	968	1,007	1,047	1,089	1,133
Net Price/Full-Time Undergraduate[d]							
High Income	160	160	750	750	750	750	750
Middle Income	160	160	215	215	215	215	215
Low Income	160	160	0	0	0	0	0
CUNY-Community Colleges							
Tuition/Full-Time Undergraduate	160	160	828	867	907	949	993
Net Price/Full-Time Undergraduate[d]							
High Income	160	160	728	750	750	750	750
Middle Income	160	160	215	215	215	215	215
Low Income	160	160	0	0	0	0	0
Independent Colleges							
Tuition/Full-Time Undergraduate	2,871	3,041	3,204	3,307	3,408	3,137	3,236
Net Price/Full-Time Undergraduate[d]							
High Income	2,121	2,291	2,454	2,557	2,658	2,387	2,486
Middle Income	1,586	1,756	1,919	2,022	2,123	1,852	1,951
Low Income	1,371	1,541	1,704	1,807	1,908	1,637	1,736

[a] Net of "income offset".

[b] Fully phased in with new TAP formula.

[c] Net of debt service.

[d] Tuition less TAP: for TAP-recipients only.

Table 4.5
PROJECTIONS OF STATE APPROPRIATIONS FOR POSTSECONDARY EDUCATION
IN NEW YORK STATE, 1977-78 TO 1980-81
($ millions)

	Appropriation for Postsecondary Education*			
Estimated	Low[a]	Mid-Range[b]	High[c]	Planning Model[d]
1977-78	$1,347	$1,378	$1,049	$1,422
1978-79	1,439	1,479	1,518	1,493
1979-80	1,524	1,579	1,634	1,567
1980-81	1,657	1,699	1,740	1,639

[a]Low estimate by the State Education Department based on estimates by the Director of the Budget of a declining share of State funds allocated for education.

[b]Mid-Point of low and high estimates.

[c]High based upon assumption that 12.4 percent of State revenues, the State funds allocated to higher education for 1975-76, is allocated for postsecondary education.

[d]Excluded costs as inflated by the inflation factor are added in here.

*Board of Regents, 1976, p.89.

Independent sector tuition increases through 1978-79 in the Regents run as in the Tuition run, although for 1979-80 and 1980-81 tuition in the Regents run was about $40 less than in the Tuition run. The independent sector tuition was less in these two years because of the increased institutional aid to the independent sector provided by the financing strategy.

Enrollments in the two runs were very similar although in the Regents run public enrollments were slightly lower in 1979-80 and 1980-81 than in the Tuition run. This can be attributed in part to the increase in net price as caused by the inflated tuition rates.

Increased tuition revenues in State University-State Operated and City University-Senior Colleges more than offset TAP increases for all the sectors. Table 4.6 summarizes the increase TAP and tuition revenue figures for all the public sectors.

The Regents goal of 80 percent State funding for City University-Senior Colleges is attained by 1979-80. The State's share of City University-Senior's net operating budget reaches its 1979-80 target of 80 percent by steady yearly increases. The percentages as determined by the model in the SWP run were:

Year	Percentage of Net Operating Budget of CUNY-Senior Colleges from State
1975-76	50 percent
1976-77	60 percent
1977-78	65 percent
1978-79	75 percent
1979-80	80 percent
1980-81	80 percent

Table 4.6
SUMMARY OF TAP/TUITION CALCULATIONS FOR 1976-77
($ millions)

Public Sector	(1) Change in TAP Expenditures	(2) Change in Tuition Revenue to State	(3) Net Gain (or loss) to State
SUNY-State Operated	$+12.5	+26.0	+13.5
SUNY-Community Colleges	+ 5.1	—	(5.1)
CUNY-Senior Colleges	+ 7.3	+ 9.7*	+ 2.4
CUNY-Community Colleges	+ 1.0	—	(1.0)
Totals	25.9	35.7	9.8

*Assumes that the State share is 60 percent of the CUNY-senior net operating budget - hence, the State's share of the CUNY-senior additional tuition revenue is 60 percent of the increase ($14.14 million) or $9.7 million.

6% Inflation Run

Table 4.7 summarizes the results of a run designated to test the sensitivity of the results to changes in the rate of inflation. Except for a 6 percent inflation factor this run is identical to the tuition run which had a 4 percent inflation rate. This run is referred to as the "6% inflation run."

The major impacts of the 6 percent inflation rate can be found in the following areas: independent sector balanced budget; private sector tuition; 1977-81 enrollments; and total state expenditures. The inflation rate has the largest effect on the independent sector. This sector appears to benefit from the larger inflation rate insofar as added costs are more than offset by added revenues. The budget in the independent sector comes

Table 4.7
SELECTED OUTPUT STATISTICS FROM "6 PERCENT INFLATION RUN"
(New Tuition; New Bundy Formula; 6 Percent Inflation)

	1974-75 (000,000)	1975-76 (000,000)	1976-77 (000,000)	1977-78 (000,000)	1978-79 (000,000)	1979-80 (000,000)	1980-81 (000,000)
PUBLIC OUTLAYS							
TOTAL STATE EXPENDITURES ($ Millions)	$1,175.1	$1,275.7	$1,317.1	$1,374.6	$1,449.4	$1,540.3	$1,641.3
A. State Appropriation							
SUNY-State Operated[a]	$ 632.0	$ 695.7	$ 711.8	$ 763.2	$ 822.0	$ 884.2	$ 958.0
SUNY-Community Colleges	79.7	91.5	101.5	109.4	116.4	123.1	130.2
CUNY-Senior Colleges	172.4	183.8	136.1	130.3	128.2	142.3	156.5
CUNY-Community Colleges	62.4	66.7	69.8	74.8	85.4	93.3	99.9
Independent Colleges (BUNDY)	55.4	57.4	66.7	69.5	70.4	71.5	71.0
B. TAP Total	$ 148.4	$ 154.8	$ 206.1	$ 202.8	$ 202.3	$ 201.3	$ 201.0
C. Regents Scholarships	$ 22.3	$ 23.1	$ 22.6	$ 22.2	$ 22.1 0	$ 22.1	$ 22.1
ACCUMULATED OPERATING BALANCE ($ Millions)							
Independent Colleges	$ (140.8)	$ (206.5)	$ (200.5)	$ (132.9)	$ (29.6)	$ (32.2)	$ 42.4
INSTITUTIONAL EXPENDITURES ($ Millions)							
SUNY-State Operated[c]	$ 721.4	$ 791.9	$ 819.9	$ 872.1	$ 932.8	$ 996.8	$1,074.4
SUNY-Community Colleges[c]	212.5	244.1	270.7	291.6	310.4	328.1	347.3
CUNY-Senior Colleges[c]	391.6	410.0	373.4	348.0	334.5	365.8	396.3
CUNY-Community Colleges[c]	166.4	178.0	186.1	199.3	227.8	248.7	266.5
Independent Colleges	1,840.8	2,001.1	2,178.2	2,330.2	2,498.6	2,635.5	2,783.8
PERCENT OF FULL-TIME FIRST-TIME FRESHMEN ENROLLED	100 %	100 %	73 %	77 %	81 %	95 %	96 %
ENROLLMENT SUMMARIES							
A. Total Full-Time Equivalent (Graduate and Undergraduate)	703,800	733,000	720,800	711,800	712,900	716,600	720,700
SUNY-State Operated	148,200	157,200	150,200	150,900	153,000	154,800	159,200
SUNY-Community Colleges	103,200	112,300	117,700	119,800	120,300	119,900	119,700
CUNY-Senior Colleges	128,700	128,900	109,100	93,100	81,900	64,400	65,100
CUNY-Community Colleges	64,400	65,100	64,100	64,800	70,500	72,800	73,600
Independent Colleges	259,400	269,600	279,700	283,300	287,300	283,900	280,900
B. Undergraduate Enrollment							
SUNY-State Operated							
Full-Time	117,100	124,200	115,700	115,900	117,200	118,600	122,400
Part-Time	23,500	25,800	27,500	27,900	28,600	28,600	28,800
SUNY-Community Colleges							
Full-Time	71,500	75,500	80,800	82,000	82,000	81,400	80,600
Part-Time	63,200	73,600	74,000	75,600	76,500	77,000	78,200
CUNY-Senior Colleges							
Full-Time	87,900	89,900	74,600	61,900	53,500	55,300	57,600
Part-Time	49,400	51,000	48,700	42,800	37,300	39,400	38,800
CUNY-Community Colleges							
Full-Time	44,200	43,700	45,400	47,200	51,000	52,300	52,100
Part-Time	40,400	42,700	37,400	35,300	39,000	41,000	43,000
Independent Colleges							
Full-Time	173,800	180,100	185,200	186,700	188,100	182,900	178,200
Part-Time	55,300	60,300	63,900	66,700	67,700	69,000	69,900
Total Full-Time Undergraduates	494,500	513,400	501,600	493,600	491,700	490,500	490,900
Total Part-Time Undergraduates	231,900	253,300	251,300	248,200	249,100	255,000	258,600
STUDENT PRICE SUMMARIES							
SUNY-State Operated							
Tuition/Full-Time Undergraduate	710	710	810	810	810	810	810
Net Price/Full-Time Undergraduate[d]							
High Income	610	610	710	710	710	710	710
Middle Income	215	215	215	215	215	215	215
Low Income	0	0	0	0	0	0	0
SUNY-Community Colleges							
Tuition/Full-Time Undergraduate	570	570	670	670	670	670	670
Net Price/Full-Time Undergraduate[d]							
High Income	470	470	570	570	570	570	570
Middle Income	215	215	215	215	215	215	215
Low Income	0	0	0	0	0	0	0
CUNY-Senior Colleges							
Tuition/Full-Time Undergraduate	160	160	835	835	835	835	835
Net Price/Full-Time Undergraduate[d]							
High Income	160	160	735	735	735	735	735
Middle Income	160	160	215	215	215	215	215
Low Income	0	0	0	0	0	0	0
CUNY-Community Colleges							
Tuition/Full-Time Undergraduate	160	160	775	775	775	775	775
Net Price/Full-Time Undergraduate[d]							
High Income	160	160	675	675	675	675	675
Middle Income	160	160	215	215	215	215	215
Low Income	160	160	0	0	0	0	0
Independent Colleges							
Tuition/Full-Time Undergraduate	2,871	3,041	3,200	3,295	3,337	2,834	2,989
Net Price/Full-Time Undergraduate[d]							
High Income	2,121	2,291	2,450	2,545	2,587	2,084	2,239
Middle Income	1,586	1,756	1,915	2,010	2,052	1,549	1,704
Low Income	1,371	1,541	1,703	1,795	1,837	1,334	1,489

[a] Net of "income offset".

[b] Fully phased in with new TAP formula.

[c] Net of debt service.

[d] Tuition less TAP: for TAP-recipients only.

into balance more rapidly in the 6% inflation run than in the Tuition run. In 1977-78, the independent sector budget is $68.1 million closer to even; $90.4 million in 1978-79; $44.6 million in 1979-80; and in 1980-81 a $20.2 million larger surplus is shown. Because of this improved budget balance situation, independent sector tuition is lower by $340 and $288 in 1979-80 and 1980-81 in the 6% inflation run than in the tuition (4 percent) run.

This tuition decrease in turn causes enrollment in the independent sector for 1980-81 to increase slightly (0.3 percent). This is because the net price to students in the independent sector, who are already receiving the maximum TAP award, decreases by the amount of tuition decrease (approximately $300).

The effects of the larger inflation rate on total state expenditures for higher education are summarized in Table 4.8.

Table 4.8
COMPARISON OF TOTAL STATE EXPENDITURES
IN 6% INFLATION AND TUITION RUNS

	6% Inflation Run		Tuition 4% Run	
	Total State Expenditures ($ millions)	Percent from Previous Year Change	Total State Expenditures ($ millions)	Percent from Previous Year Change
1974-75	$1175.1	—	$1175.1	—
1975-76	1275.7	8.56%	1253.9	6.70%
1976-77	1317.1	3.24	1273.1	1.53
1977-78	1374.6	4.36	1306.8	2.64
1978-79	1449.4	5.44	1353.0	3.53
1979-80	1540.3	6.29	1409.0	4.13
1980-81	1641.3	6.55	1471.3	4.42

The average increase in total state expenditures from 1975-76 to 1980-81 was approximately 5 percent and 3 1/2 percent for the 6% inflation and

tuition runs respectively. The result of the 2 point increase in the inflation rate is translated into a 1 1/2 percent increase in state expenditures. This implies that the added revenues due to the higher inflation rate exceed the added costs. This point serves as a reminder of the subtlety of some of the relationships in the model and the need for care in applying complex modeling procedures in a policy-making environment.

CHAPTER 5

SUMMARY AND CONCLUSIONS

Demands for information and accountability have been increasing for higher education in recent years. This has led agencies in many states to develop information systems and analytical tools to improve understanding of higher education and how it operates. This report describes an analytical tool developed by the New York State Education Department for analyzing state-level financing strategies for higher education. The ultimate objective of this Financial Planning Model is to enable the Regents and others to evaluate policies, make decisions, and allocate resources more effectively. The Model is still experimental, but it has been tested and refined sufficiently to warrant distribution of this report so that others can evaluate the possibility of using this kind of model in their own situations.

Analysis of state-level financing strategies is not an easy task, nor is the formulation of appropriate models. Figure 3.2 (page 23), which presents the detailed block diagram for the model used in the pilot-test activities, shows the wide variety of relationships and parameters which have been included in the model.

There were some major decisions that had to be made concerning the structure of the model. A choice had to be made between a formulation that permitted optimization over the entire higher education system and one that optimized the institutional and state aspects of the model separately. The former was chosen because it was felt that the added realism would compensate for the increased cost of running the model.

The chosen design is particularly well suited to the analysis of several types of questions:

(1) What would be the impact of a change in tuition in one or more institutional sectors?

(2) What would be the financial impact of different enrollment levels in future years?

(3) What would be the impact of different award maximums for the State's student aid program (i.e., the Tuition Assistance Program)?

(4) What would be the impact of changing the award levels for the State's aid program for independent institutions (i.e., the Bundy Aid Program)?

Considerable data is required to support a model to study such questions. Estimation of many of the parameters used in the model was an easy task. For some, however, significant analytical effort was required. In some cases, this involved data items not usually collected and a variety of statistical analyses and manipulations. Appendix B describes analyses performed in developing some of the important inputs to the model.

Although data collection and preparation did require significant effort, it would be misleading to say that this effort was relevant only to the model development. It also had several spinoff benefits. It led to improved understanding of a number of aspects of higher education; it identified areas in which improved data collection would be appropriate; and it strengthened the informal communication network that exists between analysts and data providers in the State.

ADVANTAGES OF THE MODEL

As a tool for studying financing strategies for higher education in New York State, the State Financial Planning Model has a number of advantages over other approaches:

(1) The model is relatively comprehensive. It incorporates all major factors and relationships that are known to be relevant to state-level financing of higher education. Important relationships are less likely to be ignored or overlooked than with less systematic procedures.

(2) The basic relationships in the model correspond to the real world. Considerable effort has gone into the development of parameters and equations that accurately reproduce the effects of actual situations and programs.

(3) The model performs many calculations in a short time. If the problem to be solved corresponds closely to the model, answers can be provided quickly and accurately.

(4) Even if one rejects the numerical results of the model, the process of formulating and using the model can be very useful. It forces a discipline on an analyst that can have significant benefits. It brings into question the relationships being studied, the data, and even the policies and strategies under consideration.

SHORTCOMINGS OF THE MODEL

When evaluating a quantitative model, one must consider not only positive aspects. It is also important to understand its weakresses and limitations. The State Financial Planning Model has several limitations, most of which are a result of insufficient data, rather than problems with the structure of the model:

(1) The large drop in enrollments for The City University in 1976 cannot be fully explained by the model because the enrollment decrease is not fully attributable to factors

included in the model (e.g., tuition levels). In the real world, the City's fiscal problems dominated patterns and relationships that had existed in the past, and the model could not duplicate the results.

(2) Federal aid is not explicitly incorporated into the model, primarily because required data are not available.

(3) The coefficients reflecting student response to net price changes (i.e., the price elasticities) are based on a survey that yielded questionable results because of the small sample size, and because of bias in the sample.

(4) More accurate non-tuition costs (i.e., food, housing, and travel) need to be incorporated into the model.

(5) The accuracy of the City University appropriation formula is questionable. The actual formulas and procedures are not well documented.

(6) Five institutional sectors may be too few; a more detailed categorization of institutions might lead to more accurate results. It would also result in higher operating costs for the model.

Most of these shortcomings are unique to the particular model formulation developed in this project. However, others may run into similar problems with certain types of data and relationships depending on the planning environment and the model formulation selected.

VALIDATION OF THE MODEL

Any model requires validation prior to serious consideration as an operational planning tool. This is particularly true of a model like the State Financial Planning Model which is designed to analyze financial strategies with significant fiscal and policy implications for both institutions and the State.

The major work on validating the model was done by the project staff. Most of this effort was devoted to ensuring that the numbers produced by the model were reasonable and realistic. Some of this work resulted in the addition of new parameters and equations required to make the model reflect actual procedures and relationships more accurately. Some was related to inaccuracies and discrepancies in input data because different sources of data were required in many cases. And some was related to the multi-criteria optimization feature of the model, which occasionally required adjustments in the targets and tolerances in the objective function.

The project advisory committee also played a part in validating the model, although its role was less direct. It met several times to review the design of the model, advise on data sources, review the numerical results, and comment on the relevance of the model to state-level planning. The representatives of the institutional sectors were most helpful in pointing out parts of the model that needed additional work.

As a result of the validation work on the model, the numerical results are generally quite realistic. There is no obvious reason to reject them or to prefer another set of results obtained from an alternative formulation of the model or independent computational procedures. However, as indicated above and in Appendix D, there are

enough questions about the model to say that it has not been completely validated.

ADDITIONAL CONSIDERATIONS

There are a number of other considerations about the model and its use that the project staff would like to share with the reader:

(1) Models of the complexity of the one described in this report are not developed quickly or cheaply. Appendix C describes briefly the staff and other resources required for this project.

(2) Sophisticated modeling procedures (i.e., those which deal explicitly with all or most of the relevant factors and relationships) must produce plausible results if they are to be taken seriously. The fact that this may require the use of subjective judgment with respect to both input data and value specification does not represent weak or poor methodology.

(3) Just as judgment contributes to model inputs, it must also be applied to the outputs. As runs of the model are made, specific aspects of postsecondary education may be represented unrealistically. In such cases policy makers must be reminded that the outputs are only guides. Counter-intuitive results may be inaccurate; they also may pose questions and sound warnings.

(4) Many political and social factors, not dealt with explicitly in a model, can be represented in a "proxy" sense. For example, the enrollment projections used as an input to the model do account for certain socio-economic factors,

and therefore the model itself can be said to account for these factors.

(5) In multi-criteria optimization models, different numerical results can be obtained depending upon the tolerance limits that are specified for the targets in the objective function. This problem can be dealt with if those using the model outputs play an active role in running the model, but it does require more active monitoring than some simpler types of models.

(6) Because the model and the software it uses are highly technical and sophisticated, the procedures and calculations used to obtain the numerical results can be explained only in broad, conceptual terms or by resorting to laborious, technical discourses. This could make defense of the results in the face of serious objections very difficult.

(7) One way to reduce the effect of inaccuracies in models such as the State Financial Planning Model is to use them in a comparative mode, as has been done in the applications described in this report. The user makes a series of runs, varying one factor at a time, so that "irrelevant" errors cancel out and the "true impact" of the changes can be isolated.

(8) Regardless of its role in the development of the model, the project advisory committee was one of the most valuable aspects of the project. It brought together analysts, policy makers, and institutional representatives to discuss

a variety of important questions and fostered mutual understanding.

THE BOTTOM LINE

An unambiguous evaluation of the State Financing Planning Model is probably not possible, but careful consideration of the model and its trial implementation indicate that this kind of planning tool has the potential to provide considerable assistance to higher education planners and policy-makers in New York State and elsewhere. The model is not perfect, but it has provided "realistic" results, and valuable insights have been gained through its formulation and use.

APPENDIX A

DETAILED SPECIFICATION OF THE MODEL

This appendix presents the detailed specification of the model for readers that are more technically inclined. It includes lists of the variables and their definitions, the equations used in the models, and the details of the objective function. Four conventions have been used in the detailed specifications:

1) Variables with names beginning with "X" are control variables (i.e., variables that are under the control of policy makers) which enter into the objective function in the model. The other variables are state variables which depend on the values of the control variables.

2) The subscript "J" defines institutional sectors

   J = 1 for SUNY 4-year plus Agricultural and Technical institutions
   2 for SUNY 2-year institutions
   3 for CUNY 4-year institutions
   4 for CUNY 2-year institutions
   5 for independent institutions

3) The subscript "I" defines the income groups for students

   I = 1 for high income students
   2 for moderate income students
   3 for low income students

4) The subscript "t" defines the year in which a particular relationship holds true.

VARIABLE LIST

Control (Decision) Variables

$XTUIT(J)_t$ = Average tuition cost in sector J, for full-time undergraduate students, in year t.

$XSUP(I,J)_t$ = Supply control; 1 - the fraction of first-time, full-time freshmen in income group I, (I=1, 3), "turned away" by institutional sector J, in year t; $0 \leq XSUP \leq 1$

$XPTUG(J)_t$ = Part-time undergraduate enrollment in sector J, in year t (thousands of students).

$XFTG(J)_t$ = Full-time graduate enrollment in sector J, in year t (thousands of students).

$XPTG(J)_t$ = Part-time graduate enrollment in sector J, in year t (thousands of students).

$XADIA5_t$ = Additional state institutional aid (above BUNDY formula) to institutional sector 5, in year t ($ millions).

$XADAID(I,J)_t$ = Additional student aid per full-time undergraduate (above TAP formulae) to students in income group I in sector J, in year t.

State Variables

$STAP(I,J)_t$ = Average TAP award to a full-time undergraduate student in income group I in sector J, in year t.

$SFTF(I,J)_t$ = Number of first-time full-time freshmen of income group I enrolled in sector J, in year t (thousands of students).

$SFTUG(I,J)_t$ = Number of full-time undergraduates of income group I, enrolled in sector J, in year t (thousands of students).

$SEXP(J)_t$ = Total expenditure of institutions in sector J, in year t ($ millions).

$SREV_t$ = Revenues of institutions in sector 5 (i.e., independent institutions) in year t.

$STAPG(J)_t$ = Average TAP award to a full-time graduate student in sector J, in year t.

Parameters and Constants

INC(I) = Average income of students in income group I.

TAPRED(I) = Percentage Income reduction (TAP tables) for students in income group I.

UTRATE(I,J) = TAP utilization rate; percentage of students in income group I and sector J who receive TAP payments.

$PCNET\ (I.J)_t$ = Percentage change in net tuition price from year t-1 to t, for a full-time undergraduate student in sector J and income group I.

ATTRATE(J) = Number of full-time undergraduate students in sector J, "lost" from one year to the next due to transfer and graduation. ATTRATE(J) is determined empirically as follows:

ATTRATE(J) = 1 - Retention Rate (J)

$$= 1 - \frac{ftug_t - ftf_t}{ftug_{t-1}} = \frac{ftug_{t-1} - (ftug_t - ftf_t)}{ftug_{t-1}}$$

$BUNDYU_t$ = Total Bundy Aid for Associate and Baccalaureate degrees, in year t.

$BUNDYG_t$ = Total Bundy Aid for Master's and Doctoral degrees in year t.

FIXREV = Non-variable revenues for the independent sector (i.e., Total revenues less tuition and Bundy).

I,K = 1000.

ELAST (I,J,K) = Percent of students in income group I enrolled in sector K, who transfer to sector J as a result of a 1% change in net tuition price in sector K.

GRTUIT(J) = Average graduate tuition charge in sector J.

$B(I,J)_t$ = Projected number of first-time freshmen in income group I in sector (J (t=1976/77,..., 1980/81).

DETAILED EQUATIONS

State Equations

NOTE: The five sets of equations that follow are an important part of the model. They define many of the relationships that exist among the variables defined above. Where subscripts appear, they follow the same conventions shown on the appendix heading page except where noted.

1. Computation of TAP awards.

Undergraduates:

$$STAP(I,J)_t = [\min(\$1500;\ XTUIT(J)_t) - INC(I,J) * TAPRED(1)] * UTRATE(I,J)$$

Graduates:

$$STAPG(J)_t = 156 \quad \text{(applied to all full-time graduate students)}$$

2. Computation of percentage change in price to students:

$$PCNET(I,J)_t = [XTUIT(J)_t - STAP(I,J)_t - XADAID(I,J)_t - [XTUIT(J)_{t-1} - STAP(I,J)_{t-1} - XADAID(I,J)_{t-1}] \div [XTUIT(J)_{t-1} - STAP(I,J)_{t-1} - XADAID(I,J)_{t-1}]$$

3. Enrollment Projections as modified by tuition price changes:

Price Adjustment Factor:

$$D(I,J)_t = \sum_K ELAST(I,J,K) * PCNET(I,K)_t$$

(for K=1,...5; J=1,...5; I=1,...3).

First-Time Freshmen:

$$SFTF(I,J)_t = [(B(I,J)_{t-1} - B(I,J)_{t-2} + SFTF(I,J)_{t-1}) * (1. + D(I,J))] * XSUP(I,J)_t$$

Full-Time Undergraduates:

$$SFTUG(I,J)_t = SFTF(I,J)_t + SFTUG(I,J)_{t-1} - SFTUG(I,J)_{t-1} * ATTRATE(J)$$

4. Institutional Expenditures:

$$SEXP(J)_t = a_o + a_1 * \sum_I SFTUG(I,J)_t + a_2 * XPTUG(J)_t + a_3 * XFTG(J)_t + a_4 * XPTG(J)_t$$

5. Institutional Revenues, Independent Sector Only:

Total Bundy Aid:

$$BUNDYU_t = b_1 * \sum_I SFTUG(I,5)_t + b_2\ XPTUG(5)_t$$

$$BUNDYG_t = c_1 * XFTG(5) + c_2 * XPTG(5)_t$$

where b_1, b_2, c_1, c_2 are derived empirically.

Revenue Calculation:

$$SREV_t = \sum_I STAP(I,J)_t * SFTUG(I,J)_t$$

$$+ XTUIT(J)_t * [\sum_I SFTUG(I,J)_t + (1/3) * XPTUG(J)_t]$$

$$+ GRTUIT(J) * [XFTG(J)_t + .4 * XPTG(J)_t]$$

$$+ BUNDYU_t + BUNDYG_t + FIXREV + XADIA5_t + \sum_I XADAID(I,J)_t * SFTUG(I,J)_t;$$

for J = 5

Objective Function

General Form: min $Z = \sum [f_1(X) - G_1]^2$, where G's are goals to be attained

1. Full-Time Undergraduate Enrollment

Total FTUG: $[\sum_J \sum_I SFTUG(I, J)_t - G_1]^2$

a. SUNY-FTUG: $[\sum_I SFTUG(I, 1)_t - G_{1a}]^2$

b. SUNY-2-FTUG: $[\sum_I SFTUG(I, 2)_t - G_{2a}]^2$

c. CUNY-4-FTUG: $[\sum_I SFTUG(I, 3)_t - G_{3a}]^2$

d. CUNY-2-FTUG: $[\sum_I SFTUG(I,4)_t - G_{4a}]^2$

e. INDEPENDENT-FTUG: $[\sum_I SFTUG(I, 5)_t - G_{5a}]^2$

Where G_{1a} thru G_{5a} are FTUG targets by sector.

2. Part-Time Undergraduate Enrollment

$$[\sum_J XPTUG(J)_t - G_2]^2$$

3. Full-Time Graduate Enrollment

$$[\sum_J XFTG(J)_t - G_3]^2$$

4. Part-Time Graduate Enrollment

$$[\sum_J XPTG(J)_t - G_4]^2$$

5. Balanced Budget for Independent Sector.

$$[(SEXP(J)_t - SREV_t) - G_5]^2$$

6. State Outlays for SUNY, CUNY and TAP

SUNY: State Share I = Expenditures less ("income offset" + amount by which calculated tuition revenue differs from base year tuition revenue).

SUNY-2-Year: State Share II = .40* (Expenditures)

$$= .40\,[SEXP\,(2)_t - \sum_I XTUIT\,(2)_t * SFTUG\,(I, 2)_t$$

$$- XTUIT\,(J)_t * XPTUG\,(J)_t * .5]$$

CUNY-4-Year: State Share III $= .50 * [SEXP\,(3)_t - \sum_I XTUIT\,(3)_t * SFTUG\,(I, 3)_t$

$$- XTUIT\,(J)_t * XPTUG\,(J)_t * .5]$$

$$- GRTUIT\,(J)_t * (XFTG\,(J)_t + .4 * XPTG\,(J)_t)]$$

CUNY-2-Year: State Share IV = .40 * (Expenditures)

$$= .40 * [SEXP\,(4)_t - \sum_I XTUIT\,(4)_t * SFTUG\,(I,4)_t$$

$$- XTUIT\,(4)_t * PTUG\,(4)_t * .5]$$

Total State Share = State Share I + State Share II + State Share III

+ State Share IV.

TOTAL TAP:

$$TAPTOT_t = \sum_J \sum_I STAP(I, J)_t * SFTUG(I, J)_t + \sum_J STAPG(J)_t * XFTG(J)_t + \sum_J \sum_I XADAID(I,J)_t * SFTUG(I,J)_t$$

TOTAL STATE EXPENDITURES:

$$[(\text{Total State Share}_t) + TAPTOT_t + (BUNDYU_t + BUNDYG_t) + XADIA5_t - G_6]^2$$

APPENDIX B

PARAMETER ESTIMATION FOR THE STATE FINANCIAL PLANNING MODEL

Considerable effort was devoted to assembling the input data required for the State Financial Planning Model. This appendix describes some of the analyses performed as part of this task. Separate discussions have been provided for different parameters and coefficients.

ENROLLMENTS

The enrollments for 1974-75 and 1975-76 used in this study are actual figures collected and maintained by the State Education Department in the Higher Education Data System in the Office of Postsecondary Research, Information Systems and Institutional Aid. Projected enrollments are from the Regents' Statewide Plan for Postsecondary Education for 1976. Both actual and projected enrollments in all student categories have the following exclusions:

Institutional Sector		Excluded Institutions
Public institutions	-	Health and Science Centers
	-	Specialized Colleges
	-	Statutory Colleges
Independent institutions	-	Health and Science Centers
	-	Seminaries
	-	Two-Year-Degree-Program Institutions

The State University-State Operated Sector (4-year institutions) includes enrollments from the Agricultural and Technical schools because of the similar funding patterns.

Because of these differences in institutional categories the projected enrollments for the SUNY-State operated and the Independent sectors are not in the same groupings as used in the planning model. Empirical conversion rates were developed to reflect all the differences in the classification schemes. There are summarized in Table B.1. An empirical ratio based on a weighted average of historical percentages was developed to exclude part-time undergraduates of the Agricultural and Technicals from the State University two-year category and include them with the State University-State Operated schools. Table B.2 summarized the calculations used in this process.

In addition to total enrollments the model requires data on full-time freshmen. Since these enrollments are not explicitly projected in the Statewide Plan, they have been derived as an empirical percentage of full-time undergraduates. Projected full-time freshmen are derived by applying the empirical ratio (as shown in Table B.3) to the appropriate full-time undergraduate projections.

Given this empirical basis for developing the enrollment database by sector, the full-time undergraduates and full-time freshmen are then broken down into three income levels. This is accomplished by using the same student income level percentages as discussed in the TAP section later in this Appendix.

Tables B.4 through B.8 display the detailed enrollments used in the planning model that reflect all exclusions and modifications. Each table represents one student type (e.g., full-time undergraduate) and shows the breakdowns by sector.

Table B.1
PERCENTAGES USED TO ADJUST
FULL-TIME ENROLLMENTS IN THE REGENTS STATEWIDE
PLAN TO CORRESPOND TO INSTITUTIONAL SECTORS IN THE MODEL

Year	SUNY-State Operated				Independent Colleges			
	Undergraduate		Graduates		Undergraduates		Graduates	
	FT	PT	FT	PT	FT	PT	FT	PT
1969-70	91.2%	98.8 %	63.3 %	98.7%	98.6%	99.5%	90.7%	99.4%
1970-71	91.2	99.2	66.5	98.6	98.9	99.5	91.9	99.4
1971-72	91.0	98.5	67.6	98.4	98.9	99.7	91.4	99.5
1972-73	90.6	98.4	65.2	97.9	98.9	99.2	91.6	99.2
1973-74	90.6	97.0	62.7	96.6	98.6	99.3	91.1	98.9
1975-76	90.9	94.6	64.7	96.1	98.8	99.6	90.1	98.9
Average*	90.9%	97.0%	64.8%	97.1%	98.8%	99.4%	90.9%	98.9%

*Weighted average - heavier emphasis placed on
more recent enrollments
- i.e. (1,2,3,4,5,6)

Table B.2
STATISTICS USED IN COMPUTING
ADJUSTMENTS FOR PART-TIME ENROLLMENTS
AT THE STATE UNIVERSITY

Institutional Group	Year						
	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76
SUNY Ag & Tech	5,568	6,613	7,565	8,045	7,146	7,282	8,332
Total SUNY-2 Year	53,028	56,199	60,383	63,266	65,895	70,520	81,886
Ag & Tech. Percentage	10.5%	11.8%	12.5%	12.7%	10.8%	10.3%	10.2%

NOTE: The weighted average of Agricultural and Technical percentages equals 11.1 percent, where the weighting scheme = (1,2,3,4,5,6,7).

Table B.3
FIRST-TIME FRESHMEN AS A PERCENTAGE OF
FULL-TIME UNDERGRADUATES (1973-74 to 1975-76)

	1973-74			1974-75			1975-76			Weighted Average by Years
	FTF	FTUG	$\frac{FTE}{FTUG}$	FTF	FTUG	$\frac{FTF}{FTUG}$	FTF	FTUG	$\frac{FTF}{FTUG}$	
SUNY State Operated	31,422	109,564	.287	31,810	115,536	.275	33,143	122,528	.270	.276
SUNY- Community Colleges	34,355	69,016	.498	34,355	72,557	.473	37,041	83,061	.446	.466
CUNY-Senior Colleges	16,755	84,602	.198	17,758	87,220	.204	16,993	87,550	.194	.198
CUNY-CC	14,422	41,291	.349	16,193	43,938	.369	13,680	40,170	.341	.350
Independents	42,525	168,911	.251	46,342	176,255	.262	48,792	189,438	.257	.257

NOTES: FTF = Full-time Freshmen.
FTUG = Full-time Undergraduates.
All exclusions (as in Tables B.1 and B.2) taken into account.
Weighting factors = (1,1,2).

Table B.4

ACTUAL AND PROJECTED FULL-TIME FIRST-TIME FRESHMEN ENROLLMENTS
(1973-74 to 1980-81)

	ACTUAL			PROJECTED				
Institutional Sector	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
SUNY - State Operated	31,419	31,807	33,140	31,131	31,483	31,809	32,160	33,201
SUNY - Community Colleges	34,358	34,355	37,041	40,076	38,445	37,839	37,234	37,644
SUNY - Senior Colleges	16,744	17,748	16,983	14,459	11,674	10,368	10,943	11,695
CUNY - Community Colleges	14,413	16,283	13,671	15,740	16,336	18,889	17,665	16,616
Independents	42,525	46,342	48,792	49,082	49,717	47,069	44,613	45,514
Total Full-Time First-Time Freshman Enrollments	139,459	146,535	149,627	150,488	147,655	145,974	142,615	144,670

NOTE: These figures reflect all adjustments as shown in Tables B.1 and B.2.

Table B.5
ACTUAL AND PROJECTED FULL-TIME UNDERGRADUATE ENROLLMENTS
(1973-74 to 1980-81)

	ACTUAL			PROJECTED				
Institutional Sector	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
SUNY - State Operated	109,564	115,600	122,528	114,627	115,829	116,995	118,226	121,953
SUNY - Community Colleges	69,016	72,557	83,061	86,000	82,500	81,200	79,900	78,850
CUNY - Senior Colleges	84,602	87,220	87,550	73,050	59,000	52,400	55,300	59,100
CUNY - Community Colleges	41,291	43,938	42,665	45,000	46,700	54,000	50,500	47,500
Independents	168,911	176,255	190,068	191,064	193,928	192,396	183,206	177,178
Total Full-Time Undergraduate Enrollments	473,384	495,570	525,872	509,741	497,957	446,991	487,132	484,581

NOTE: These figures reflect all adjustments as shown in Tables B.1 and B.2.

Table B.6

ACTUAL AND PROJECTED PART-TIME UNDERGRADUATE ENROLLMENTS
(1973-74 to 1980-81)

	ACTUAL			PROJECTED				
Institutional Sector	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
SUNY - State Operated	21,093	23,529	25,831	27,471	27,865	28,569	28,625	28,774
SUNY - Community Colleges	58,749	63,238	73,554	73,965	75,565	76,543	76,987	78,188
CUNY - Senior Colleges	46,502	49,382	50,964	48,650	42,800	37,300	39,400	38,750
CUNY - Community Colleges	37,032	40,428	42,712	37,350	35,300	39,000	41,000	43,000
Independents	53,096	55,325	60,248	63,873	66,706	67,702	68,498	69,293
Total Part-Time Undergraduate Enrollments	216,472	231,902	253,309	251,309	248,236	249,114	254,510	258,005

NOTE: These figures reflect all adjustments as shown in Tables B.1 and B.2.

Table B.7
ACTUAL AND PROJECTED FULL-TIME GRADUATE ENROLLMENTS
(1973-74 to 1980-81)

	ACTUAL			PROJECTED				
Institutional Sector	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
SUNY - State Operated	9,118	9,414	10,135	10,498	10,627	10,951	11,178	11,405
SUNY - Community Colleges	0	0	0	0	0	0	0	0
CUNY - Senior Colleges	4,842	5,613	4,515	3,600	3,400	3,400	3,500	3,600
CUNY - Community Colleges	0	0	0	0	0	0	0	0
Independents	37,623	38,007	39,138	40,451	40,723	42,268	43,087	43,905
Total Full-Time Graduate Enrollments	51,583	53,034	53,788	54,549	54,750	56,619	57,765	58,910

NOTE: These figures reflect all adjustments as shown in Tables B.1 and B.2.

Table B.8
ACTUAL AND PROJECTED PART-TIME GRADUATE ENROLLMENTS
(1973-74 to 1980-81)

	ACTUAL			PROJECTED				
Institutional Sector	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
SUNY - State Operated	23,494	24,796	24,748	25,537	26,023	26,411	26,945	27,479
SUNY - Community Colletes	0	0	0	0	0	0	0	0
CUNY - Senior Colleges	27,244	26,375	22,422	16,600	16,000	16,000	16,500	17,000
CUNY - Community Colleges	0	0	0	0	0	0	0	0
Independents	67,640	72,713	75,688	81,889	84,164	85,944	87,378	88,812
Total Part-Time Graduate Enrollments	118,378	123,884	122,858	124,026	126,187	128,355	130,823	133,291

NOTE: These figures reflect all adjustments as shown in Tables B.1 and B.2.

INSTITUTIONAL EXPENDITURES

Expenditure equations for each of the five sectors were derived empirically to provide a basis for estimating the total expenditures for each institutional sector. Each cost equation contains a fixed component and at most four variable components. The general form of the equations for a given institutional sector is as follows:

Total Expenditure = A+B * number of full-time undergraduates
+C * number of part-time undergraduates
+D * number of full-time graduates
+E * number of part-time graduates;

where A is the fixed cost component not dependent upon enrollment levels, and B,C,D, and E are the variable costs associate with each student type.

The same procedure was used to determine the expenditure coefficients for each institutional sector. Using actual expenditure data for 1970-71 to 1973-74, an adjusted E & G figure was derived based on an empirical percentage of total E & G. (See the next section of this appendix for the actual adjustment procedures.) The difference between total expenditures and adjusted E & G expenditures was defined to be the fixed cost component.

The variable cost coefficients for a given sector are based on 1974-75 expenditures and enrollment data. Total FTE's were computed for each institutional sector (as converted from the four student types), where the graduate FTE's were inflated by a factor of 1.78 to reflect the additional workload and expense they involve.* Through this factor

*This 1.78 cost differential factor corresponds very closely to results in studies by the State University of New York (1975b) and the Commission on Independent Colleges and Universities (1975).

a higher cost is attributed to graduate FTE's in the model. The total weighted FTE's are then divided into the adjusted E & G figure to yield the variable cost per FTE, which corresponds to full-time undergraduates. The FTE variable cost for the other types of students is then computed by multiplying this FTUG cost by the appropriate factor (e.g., 1.78 for graduate students) the specific calculations for the four sectors, based on 1974-75 data, are presented below.

Expenditure Coefficients for SUNY-State Operated*

Total Expenditures (including fringes)	$717,310,000
less Fixed Cost Component**	-283,101,000
Adjusted E & G Cost	$434,209,000

number FTUG = 115,536

" PTUG = 23,529

" FTG = 9,414

" PTG = 24,796

Let X = cost/FTE

$X[115,536 + .5\ (23,529)] + 1.78\ [9,414 + .4\ (24,796)]\ X = \$434,209,000$

Therefore,

cost/FTUG = X = $2,685

cost/PTUG = (.5)X = $1,343

cost/FTG = (1.78) X = $4,779

cost/PTG = (1.78) (.4) X = $1,912

Thus, SUNY-State Operated total expenditure = $283,097,000*** + $2,685x(FTUG) + $1,343x(PTUG) + $4,779x(FTUG) + $1,912x(PTG)

*Coefficients for this sector corresponds closely with those in the report by the State University of New York (1975b).

**Fixed component includes all types of costs (including fringe benefits for those schools not in the study). Source: SUNY/dental staff.

***Difference from fixed cost above is due to round-off error.

Expenditure Coefficients for SUNY Community Colleges

Total Expenditures (including fringes)	$214,463,000
less Adjusted E & G Cost	-203,319,000
Fixed Cost Component	$ 11,144,000

Where adjusted E & G Cost = (Total E & G Cost)x(.98289)

= (206,858,000)x(.98289) =$203,319,000

number FTUG = 72,557

" PTUG = 63,238

Let X = cost/FTE

$$X[72,557 + .5(63,238)] = \$203,319,000$$

Therefore,

cost/FTUG = X = $1,952

cost/PTUG = (.5)X = $ 976

Thus, SUNY-Community College total expenditure = $11,111,000* + $1,952 x (FTUG) + $ 976 x (PTUG)

*Difference from fixed cost above is due to round-off error.

Expenditure Coefficients for CUNY-Senior Colleges

Total Expenditures (including fringes)	$389,953,000
- less Adjusted E & G Cost	-343,994,000
Fixed cost component	$ 45,959,000

Where adusted E & G Cost = (Total E & G Cost)x(.96299)

= (357,214,000)x(.96299) =$343,994,000

number FTUG = 87,220

" PTUG = 49,382

" FTG = 5,613

" PTG = 26,375

Let X = cost/FTE

$$X[87,220 + .5(49,382)] + 1.78[5,613 + .4(26,375)]X = \$343,994,000$$

Therefore,

cost/FTUG =	X	=	$2,445
cost/PTUG =	(.5) X	=	$1,223
cost/FTG =	(1.78) X	=	$4,352
cost/PTG =	(178)(.4) X	=	$1,741

Thus, CUNY-Senior College total expenditure = $45,959,000*
+ $2,445 x (FTUG)
+ $1,223 x (PTUG)
+ $4,352 x (FTG)
+ $1,741 x (PTG)

*Difference from fixed cost above is due to round-off.

Expenditure Coefficients for CUNY Community Colleges

Total Expenditures (including fringes)	$165,759,000
less Adjusted E & G Cost	-149,457,000
Fixed Cost Component	$ 16,302,000

Where adjusted E & G Cost = (Total E & G Cost) x (.96994)

= (154,089,000) x (.96994) = 149,457,000

number FTUG = 43,938

PTUG = 40,428

Let X = cost/FTE

$X[43938 + .5\ (40428)] = 149,457,000$

$(64,125)\ X = 149,457,000$

Therefore,

cost/FTUG = X = $2,330

cost/PTUG = (.5) X $1,165

Thus, CUNY-Community College total expenditure = $16,285,000*

\+ $ 2,330 x (FTUG)

\+ $ 1,165 x (PTUG)

*Difference from fixed cost above is due to round-off error.

Expenditure Coefficients for Independent Colleges

Total Expenditures	$1,788,608,000
less Adjusted E & G Cost	-1,164,355,000
Fixed Cost Component	$ 624,253,000

Where adjusted E & G Cost = (Total E & G Cost)x(.80043)

= (1,454,662,000)x(.80043)= $1,164,355,000

number FTUG = 173,771

" PTUG = 53,340

" FTG = 32,988

" PTG = 67,482

Let X = cost/FTE

$$X[173{,}771 + .333\ (53{,}340)] + 1.78\ [32{,}988 + .4\ (67{,}482)]X = \$1{,}164{,}335{,}000$$

Therefore,

cost/FTUG = X $3,903

cost/PTUG = (.333) X = $1,301

cost/FTG = = (1.78) X = $6,947

cost/PTG = = (1.78)(.4) X = $2,779

Thus, Independent Colleges total expenditure = $624,284,000*

+ $3,903 x (PTUG) + $1,301 x (PTUG)

+ $6,947 x (FTG) + $2,779 (PTG)

*Difference from fixed cost above is due to round-off.

ADJUSTED EXPENDITURES

Since in the State Financial Planning Model the primary concern is with factors related to instruction, it is necessary to adjust some of the basic expenditure statistics to exclude selected items. The procedure used to calculate the Adjusted E & G Expenditure figures used in the model is as follows:

Adjusted E & G Expenditures = Total E & G Expenditures
less Sponsored Research Expenditures
less Other Sponsored Programs
less Indirect Costs Attributable to Such Sponsored Activities
less Student Aid
less Debt Service

The resulting figure is considered to be the most practical measure of the "cost" of providing educational services to students. This is the same procedure followed in other Department studies (e.g., State Education Department, 1976).

For the purpose of estimating the cost per student it was necessary to compute Adjusted E & G as a fraction of total E & G. The following proportions were computed based on 1974-75 data.

Sector	Adjusted E&G/Total E&G
SUNY/Community Colleges	0.98289
CUNY-Senor Colleges	0.96299
CUNY-Community Colleges	0.96994
Independent Colleges	0.80043

TUITION RATES BY SECTOR

The model uses tuition rates by sector and does not distinguish between lower and upper division undergraduate tuition rates as is actually done in the public sector. State University-State Operated tuition in the model is a weighted average of the upper and lower division tuition rates, where the weighting is based on enrollments. For 1974-75 the weighted average tuition rate for the State University-State Operated sector is $710. Tuition at State University Community Colleges was determined by dividing gross tuition and fee income (1974-75) by the number of FTE students. This resulted in a tuition rate of $570 per FTE:

Gross tuition revenue 1974-75	$59,465,000
Number of FTE students	104,176
Tuition/FTE	570

The tuitions for the State University-Operated and Community Colleges are $810 and $670 respectively, based on the same computational procedures.

The City University Senior and Community colleges average tuition and fee rates for the years preceding 1976-77 were derived from enrollment and tuition and fee revenue data. The average rate for both the Senior colleges and the Community Colleges was $160. City University Senior college tuition rates for 1976-77 and beyond are estimated to be $835 (a weighted average of upper and lower division tuition rates, $925 and $775, respectively). For the Community Colleges tuition for beyond 1976 is $775, based on the same procedures.

Tuition for the independent sector is estimated by dividing total FTE students into gross tuition and fee revenues.

For 1973:	Gross tuition and fee revenue	$652,338,000
	number of FTE students	242,354
	Est. 1973 Tuition: $2,692	$ 2,692
For 1974:	Gross tuition and fee revenue	$752,033,000
	number of FTE students	261,889
	Est. 1974 Tuition: $2,871	$ 2,871

Tuition for 1975-76 was imputed from CICU estimates for full-time undergraduate tuition. CICU estimates for FTUG tuition from 1973-74 are:

1973-74	$2,538
1974-75	$2,634
1975-76	$2,790

The planning model tuitions are different from those of CICU for 1973-74 and 1974-75 because they are imputed from both graduate and undergraduate tuition and fee revenues. By increasing the planning model tuition estimate for the independent sector in the same proportion that the CICU estimates increase, we get $3,041 as the 1975-76 tuition rate for use in the model.

BUNDY AID CALCULATIONS

Bundy aid is currently disbursed to eligible institutions based upon the number and types of degrees conferred. An empirical relationship between student types and types of degrees conferred was developed (based on 1973-74 data) in order to estimate Bundy aid as a function of enrollments.

The 1975-76 disbursement rates per type of degree were:

Bachelors	$ 800
Masters	$ 600
Doctorals	$3,000

The following pair of equations summarize the relationships between degree types and students for undergraduates and graduates:

Bachelor degrees conferred = A. Full-time Undergrads
+ B. Part-time Undergrads

Graduate degrees conferred = C. Full-time Graduates
+ D. Part-time Graduates

where A = 0.2254; B = 0.0330; C = 0.2994; D = 0.2103 are "completion coefficients" based on historical data using regression analysis. All four coefficients are statistically significant at the 90% confidence level.

These equations are used in the model to provide estimates of the numbers of degrees awarded in future years based on projected enrollments. Bundy aid is then computed as a function of these degree estimates as provided in the actual aid formula.

The regression analysis included all institutions eligible for Bundy aid. Since the analysis in the planning model excludes medical schools, appropriate adjustments were made. In addition, since the Bundy institutions are not segregated in the planning model from the rest of the private sector, a utilization rate of 90% had to be applied to the empirical coefficients, because enrollments in "Bundy institutions" account for 90% of the students in the independent sector. Thus, the Bundy aid amount calculated has been adjusted to reflect only the "Bundy institutions."

PARAMETER ESTIMATION FOR TAP FORMULAS

The planning model categorizes students into three income levels as follows:

Gross Income	Income Category	Average Net
0 - $7,499	Low Income	$1,347
$7,500-$14,999	Middle Income	$5,485
$15,000 +	High Income	$12,214

The percentage of students within each income level is different for the five sectors as shown in Table B.9.

Table B-9.
PERCENTAGES OF STUDENTS IN DIFFERENT INCOME CATEGORIES, BY SECTOR

Institutional Sector	Low Income	Middle Income	High Income	Total
SUNY-State Operated	23.89%	37.22%	38.89%	100%
SUNY-Community Colleges	26.57%	39.27%	34.16%	100%
CUNY-Senior Colleges	27.50%	37.45%	35.05%	100%
CUNY-Community Colleges	27.50%	37.45%	35.05%	100%
Independent Colleges	26.26%	34.94%	38.80%	100%

Given these average income levels, the TAP formulas can be completed. For each income level, the reduction from the maximum award (lesser of tuition or $1,500) and the upper limit on the award can be computed based on the actual TAP formula. The actual figures used in the model are:

	Low Income	Middle Income	High Income
TAP reduction	$ 0	$ 215	$750.
TAP limit	$1,500	$1,285	$750.

UTILIZATION RATE FOR TAP COMPUTATIONS

Since not all students are TAP recipients, a utilization rate is used to impute TAP awards over all full-time undergraduates. The utilization rates by sector, based on historical data from the State Education Department are:

SUNY-State Operated	72.72%
SUNY-Community Colleges	60.77%
CUNY-Senior Colleges	72.72%
CUNY-Community Colleges	60.77%
Independent Colleges	46.03%

Because no historical TAP information for the City University exists, the State University utilization rates have been used for CUNY.

FIXED REVENUE COMPONENTS

Both the independent sector and the State University-State Operated sector have significant fixed revenues that must be accounted for. The resulting figures were used for all subsequent years in the models, with appropriate adjustments for inflation.

Independent Sector

To determine the fixed revenue component for the independent sector, tuition and fee income (1974-75) was subtracted from total current fund revenues. The result was approximately $928 million. This figure excludes schools not in the analysis (i.e., medical schools).

Total Current Fund Revenues (1974-75)	$1,680,341,000
less: Tuition and Fee Income (1974-75)	$ 752,033,000
Fixed Revenues Component	$ 928,308,000

SUNY-State Operated

Estimation of the fixed revenue component is more complicated for the State University because of funding procedures. The State appropriation for SUNY-State Operated institutions is total expenditures, less an "income offset" which represents the net income remaining after debt service has been subtracted from the gross tuition and fee revenues. The "income offset" fluctuates from year to year in response to budgeting and legislative demands.

For the purposes of the planning model a figure of $90 million has been used as the "income offset" for the run year (1974-75). This figure, which is a rough estimate based on discussions with State University staff is one possible area in which the model could be improved. Changes in the "income offset" in subsequent years are related to changes in tuition revenues from the run year (1974-75 tuition revenue: $115.8 million). Thus, the $90 million "income offset" is adjusted by the amount by which the tuition revenue differs from the 1974-75 tuition revenue.

STUDENT TRANSITION RATES

In the present formulation it is assumed that once students are enrolled they progress through the institutions according to a predetermined pattern (i.e., increases in tuition do not affect transition rates). The term transition rate is used instead of attrition rate because the empirical rates used in the model involve more than just attrition; they implicitly include dropouts, continuing and returning students, and transfer students as well. The transition rate is determined empirically as follows:

$$\text{Transition rate}_t = 1 - \text{retention rate}$$

$$= 1 - \frac{FTUG_{t+1} - FTE_{t+1}}{FTUG_t}$$

$$= \frac{FTUG_t - (FTUG_{t+1} - FTF_{t+1})}{FTUG} ;$$

where $FTUG_t$ = full-time undergraduate in year t,

FTF_t = full-time, first time frosh in year t,

t = year

Table B.10 displays the empirical transition estimates for each sector used in the models. Both five-year average transitions and regression-based estimates are shown. The planning model currently uses the regression estimates because it is believed they are more indicative of recent trends.

PRICE AND INCOME ELASTICITY OF DEMAND FOR POSTSECONDARY EDUCATION BY SECTOR

To reflect the sensitivity of students to changes in the cost of college attendance, elasticities of demand are incorporated into the model. The elasticities in the model are estimates of the percentage change in enrollment in a given institutional sector given a one percent change in net price (ECON, 1976). Net price for a given student is defined to be tuition plus $1,500 less scholarship awards (e.g., TAP awards) and Federal aid. $1,500 is a rough estimate of the food, housing, and other miscellaneous costs incurred by students not included in the tuition charges.

The sample of students used in estimating the elasticities was drawn from 1974 TAP recipients and was therefore biased. The survey did not collect any City University data, hence, CUNY price elasticities

Table B.10
TRANSITION RATES OF ENROLLED STUDENTS, BY SECTOR*

Year	Institutional Sector				
	SUNY 4-yr.	SUNY 2-yr.	CUNY 4-yr.	CUNY 2-yr.	Independents
1969-70	.17097	.43883	.11646	.32035	.24314
1970-71	.20628	.44854	.14987	.36575	.24068
1971-72	.24980	.49075	.20932	.27660	.26826
1972-73	.23543	.47229	.16945	.31977	.25870
1973-74	.22874	.44788	.17928	.33215	.20896
Average	.21824	.45966	.16308	.32292	.24395
Regression	.22182	.46115	.17042	.32073	.24451

*The figures in the table represent the proportion of the current year's undergraduate class that will not be carried forward to the following year.

**Regression model used has the following :

$$N_t = B^* (FTUG_t)$$

where: $N_t = [FTUG_t - (FTUG_{t+1} - FTE_{t+1})]$

B = coefficient to be determined by the regression run.

were based on State University figures. Thus, in the model, the percentage of students migrating to other sectors as a result of a price change in a City University sector is the same as for the corresponding change in the State University.

The price elasticities used in the model are displayed by income level in Table B.11. A comparison was made between the new elasticities and the price response coefficients used in other studies of student demand (Jackson and Weatherby, 1975; Miller and Radnor, 1975). The elasticities developed by ECON were of the same order of magnitude, although they were in the low end of the range. This is an indication that the 1974 TAP recipients were somewhat less concerned about changes in net cost than were the students in the 1972 national study. This is not entirely surprising since the TAP recipients are already enrolled in college and have been provided aid. Migration of students from one sector to another as estimated from the cross-elasticities also appears to be somewhat smaller. The middle and high income price elasticities have smaller migration rates to other sectors due to a price change.

The elasticities in the model are probably the "weakest link" in the entire analysis. Additional study to obtain new estimates for these important coefficients is currently underway.

Table B.11
PRICE ELASTICITIES BY INCOME LEVEL

Sector in Which Net Price Changes	Sector in Which Enrollment Changes: SUNY St.Oper.	SUNY CC	SUNY Senior	CUNY CC	Independent
LOW INCOME					
SUNY-State Operated	-.21	.01	.06	.01	.03
SUNY - CC	.03	-.11	.03	0.	.02
CUNY - Senior	.04	.01	-.21	.01	.02
CUNY - CC	.02	0.	.02	-.11	.01
Independents	.06	.01	.06	.01	-.12
MIDDLE INCOME					
SUNY - St.Operated	-.28	.01	.10	.01	.05
SUNY - CC	.02	-.17	.02	0.	.03
CUNY - Senior	.05	.01	-.28	.01	.03
CUNY - CC	.02	0.	.02	-.17	.03
Independents	.07	.03	.07	.03	-.13
HIGH INCOME					
SUNY - St.Operated	-.27	.02	.07	.02	.11
SUNY - CC	.02	-.19	.02	0.	.05
CUNY - Senior	.03	.01	-.27	.01	.05
CUNY - CC	.01	0.	.01	-.19	.02
Independents	.07	.03	.07	.03	-.12

NOTE: The figures in the table are percentages of students in income Group I enrolled in Sector K, who transfer to sector J as a result of a 1% change in net tuition price in sector K.

EXCLUSION OF COSTS IN TOTAL STATE EXPENDITURES

A number of state expenditure items were excluded from the calculation in the model. These items were felt to be either peripheral to the main thrust of the model (e.g., medical/dental school aid) or difficult to support with data (e.g., opportunity programs).

The items not included in total state expenditure (and the amounts for 1974-75) are:

(1)	Aid to Medical and Dental Schools	$21.2 million
(2)	Program for Disadvantaged Students	17.2
(3)	Misc. State Education Department Programs	9.2
	— SED - Higher Education Services — SED - Professional Education Services — Regents Exam. & School Services — Einstein and Schweitzer Chairs — Teacher Training Grants — Education of Native Americans	
(4)	Other SUNY Appropriations	14.2
(5)	Apps. to other State Agencies	7.5
(6)	Misc. Aid to Students	10.2
	— SUNY Scholarships — Fellowships	
	TOTAL EXCLUSIONS	$79.5 million

APPENDIX C

THE NCHEMS STATE PLANNING SYSTEM SOFTWARE

In developing the State Financial Planning Model, the State Education Department used computer software developed by the National Center for Higher Education Management Systems (NCHEMS). This software, which was originally referred to as the State Postsecondary Education Planning Model, is now called the State Planning System (SPS). The system is described in the report by Bassett et al, 1977.

The SPS software in general was very effective. In the New York pilot test activities, the second version of the software was installed and used on two different computer systems, General Electric Time-Sharing Services and a Univac 1110 at the State University of New York at Albany. In both instances the software worked well, although the billing algorithm of the GE system made the model very expensive to operate in the optimization mode. The documentation of the software (Chisholm et al, 1977) was more than adequate.

The SPS software is sufficiently flexible to accommodate all the desired reltionships included in the New York State model. This is not to say that the task was a simple one; but the major difficulties were not related to the software. Most of the problems were related to coordinating desired relationships with available data.

Because of the complexity of the Department's model, some difficulties were encountered in obtaining satisfactory initial runs. Tolerances and weights in the objective function could not be left to chance; some simple analyses had to be performed. The procedures outlined in the operations guide (Chisholm et al, 1977) provided a satisfactory basis for specifying initial conditions for the model.

The data-handling and report-generating capabilities of the software are adequate, much better than in other quantitative modeling packages. Problems were encountered in the New York State application because of uncertainties about what output statistics were desirable and useful. Once these decisions were made, however, there were no serious problems encountered in generating appropriate reports. Labels and names could be added to reports to make them readily usable.

As multi-criteria non-linear optimization models go, the State Financial Planning Model is enormous. Each iteration through the algorithm involves thousands of calculations. It appears that the optimization algorithm provided by NCHEMS is significantly faster than others that have been available in the past.

LOGISTICS AND RESOURCES

The entire project to develop the model, compile the necessary input data, pilot-test the SPS software, and prepare the final reports took approximately two years and cost approximately $150,000. This includes staff time, computer costs, meeting costs, and all other expenses. The task could be replicated today for less than half that, with most of the resources required for data compilation and preparation.

An effort was made to determine the minimum skill levels required to carry out the development of the model. Initially, a Ph.D. in quantitative economics oversaw the project. Subsequently, a change was made to a BS-plus in operations research with part-time assistance from a computer programmer and review and guidance by a Ph.D. in operations research. This latter arrangement would probably be the minimum requirement for the particular model developed in New York State. Less sophisticated applications of SPS might be managed by a person with a technical BS and some relevant experience.

APPENDIX D

STATEMENT BY THE PROJECT ADVISORY COMMITTEE

In the summer of 1975 Education Commissioner Ewald Nyquist invited a group of individuals to serve on an Advisory Committee to the New York State Education Department and its Policy Analysis and Planning Project. (The names of the Committee members are listed in the Acknowledgments section.) The Committee's functions were mainly to assist in the development of the project and to provide guidance and commentary on the ongoing work. The Committee met approximately every other month with a final meeting held in October 1976. Seven major comments about the project are offered by the Committee:

(1) The primary activities of the Committee were to provide reactions to and suggestions for the efforts carried out in the Office of Postsecondary Planning. The research was at first under the overall direction of Mr. Shimon Awerbuch who was succeeded by Mr. Paul Wing. Because the project involved the development of a complex and technically demanding model much time and attention was given by the Committee to learn about these advanced techniques. At the same time, the insights and policy experience Committee members brought to their task were timely and, it is hoped, helpful to those mainly responsible for the construction of the model. The Committee has been pleased with the prompt and sensitive reactions of the Department staff, and is grateful for their cooperation. The Committee believes that the relationship was a productive one.

(2) The Committee is persuaded that much high powered talent has gone into the development of the model, and that the quality of what has been accomplished is commendable. Given the state of the art of model building, the members of the Department of Education have

done a fine job and, depending on available resources to the Department, they should be encouraged to devote further attention to refining the present model and developing new ones.

(3) The Committee views its participation in the work as an interesting and valuable experience. Being confronted by systematic statistical information and explicitly formulated relationships (equations) did force the Committee to concern itself with the adequacy of definitions, data, and relationships. The Committee is impressed with the kinds of techniques embodied in the model which allow the researchers to carry out their analyses; the Committee was equally impressed by the continued importance of using judgments and intuition as part of the modeling activity. Introducing significant judgmental and intuitive factors into the modeling process (to provide "realistic" results) gave pause with concern to the Committee in rationalizing the degree of value of the model processes. It is hoped that further study and model sophistication will reduce the subjective forces in the model as mathematical functions more accurately serve as proxies of reality.

(4) As the authors of the monograph clearly recognize, the model and its results in their present form have very limited, direct policy application. The number of factors that could be included is insufficient, the mathematics and computer capacity are inadequate, and the understanding of institutional and student behavior is too limited, to allow the construction of a model that has immediate and broad policy application. The Committee therefore cannot endorse the statistical findings or recommend the use of these

techniques to policymakers without also calling attention to all inherent limitations of the approach. The Committee is not unanimous in its views on the intrinsic value of modeling in policy analysis, but even those who are its strongest supporters must underscore the limitations of the approach, and the importance of avoiding simplistic applications.

(5) The Committee feels that the greatest value of the exercise for policymakers as well as its own members has been to raise questions rather than to offer clear and neat answers. The approach also might be helpful in suggesting policy alternatives and trade-offs which the Committee recognizes as useful purposes of analytical work.

(6) The use of an Advisory Committee of the sort represented in this effort has both advantages and disadvantages. The Committee represents a broad spectrum of concerned and knowledgeable individuals in higher education or related fields who brought to the task practical experience and enthusiasm. The Committee tried to be helpful in reviewing the tools used by the analysts, suggesting questions to be addressed, and commenting on the appropriateness of the results. However, the Committee lacked the capacity and time to provide much help in technical and statistical matters. Also, because the Committee brought to its task different perspectives and values, its conclusions and recommendations to members of the State Education Department were not always unanimous.

(7) In conclusion, the Committee appreciated the opportunity to participate in the difficult process of model building and to

assist the hard working members of the State Education Department. We commend the monograph to all those interested in analytical work and education policy, and hope that the model will help to stimulate them to think more systematically about the enormously, yet still little understood, interrelationships between all sectors of higher education and the government.

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